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RECONNAISSANCE WACCAMAW RIVER BASIN NORTH CAROLINA AND SOUTH CA--ETC(U)
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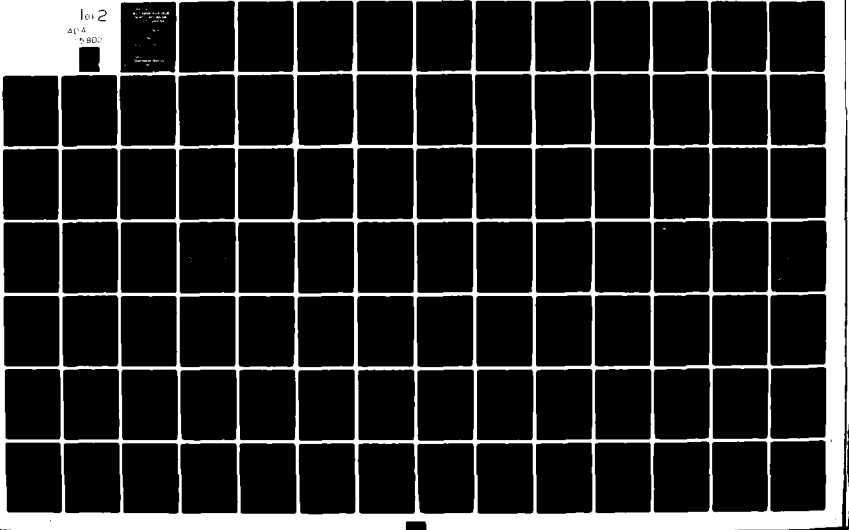

Interim Report

RECONNAISSANCE

WACCAMAW RIVER BASIN NORTH CAROLINA AND SOUTH CAROLINA

FLOOD CONTROL AND RELATED PURPOSES

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

Charleston District

SEPTEMBER 1981

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Flood Control

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The urban area of Conway, S.C., and adjacent improved agricultural lands are subject to frequent flooding. Inadequate drainage of the tributary areas is also a major problem. This condition is complicated by the fact that the Waccamaw River is a slow draining river.

Results of reconnaissance investigations, however, indicated that there are no problems in the Waccamaw River Basin which need, or could be addressed with

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a basin wide resolution. Problems which would be treatable under programs administered by the Corps of Engineers may be addressed under and within the funding limits of continuing authority programs. The only problems which appear to require treatment at this time are the urban flooding problems near Conway, S.C.

Agricultural flooding and drainage problems are very local in nature and do not fall under the purview of Corps authority. In downstream areas, the various agriculturally oriented tributary streams are swamps. Such wetlands are protected by existing legislation and development of these areas is discouraged. Agricultural flood control and drainage are very low on the national priority list.

This report recommends that the general investigation authorizing this study, be terminated on the basis of preliminary study findings and that the requirements of the resolution be considered satisfied.

RECONNAISSANCE REPORT
WACCAMAW RIVER BASIN
NORTH CAROLINA AND SOUTH CAROLINA

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STAGE 1 RECONNAISSANCE REPORT

INTRODUCTION

AUTHORITY

The Waccamaw River Basin Survey is being conducted in accordance with a resolution by the Committee on Public Works of the House of Representatives, United States, adopted 19 October 1967, which authorized the review of the report on Waccamaw River, submitted to Congress 22 December 1966, and prior reports, to determine the advisability of modifying the recommendations, with particular reference to flood protection to the main stem and tributary areas and to the development and maximum utilization of the water resources of the basin.

PRIOR REPORTS

Numerous flood control and navigation studies have been completed on the Waccamaw River - many of the continuing authority type. Between the time this study was authorized and funded, several pertinent studies have been completed.

Information on Corps of Engineers' surveys processed up to and including the 1966 report under review are listed as follows:

a. S. Ex Doc 117, 46th Congress, 2nd Session, 6 Mar 1880
This report recommended a 12-foot channel to Conway and a cleared channel to Lake Waccamaw. Construction was completed about 1924.

b. S. Doc. No. 30, 48th Congress, 1st Session, 27 January 1883
Report recommended clearing and snagging from Conway to Lake Waccamaw. No further improvements were recommended.

c. H.D. No. 514, 58th Congress, 2nd Session, 3 Feb 1904
Report considered a 12 foot channel from the mouth to Bucksville and a 6-foot channel to Conway. (Negative finding)

d. N.D. No. 467, 69th Congress, 1st Session, 24 June 1926
Report considered navigation improvements on Waccamaw River between Starr Bluff, S. C. and Lake Waccamaw, N. C. (Negative finding)

e. N.D. No. 82, 70th Congress, 1st Session, 3 July 1930
Report considered securing a channel 4 feet deep by 50 feet wide between Conway and Red Bluff. Construction was completed about 1931.

f. Review of H.D. No. 514, 58th Congress, 2nd Session, 18 Sep 1936 Not Printed
Report of review of main stem navigation improvements at Conway, S. C. and in the Kingston Lake area. Existing improvement found adequate; no further improvement recommended.

g. PL 728, 74th Congress, 24 Feb 1937, Not Printed
Preliminary examination for flood control resulted in a negative recommendation.

h. Report submitted to Congress 10 Dec 1941
Report on flood control considering channel improvement and a diversion canal to the headwaters of Little River. (Negative recommendation)

i. Report submitted to Congress 22 Dec 1966
Survey Report on water resource needs of the Waccamaw Basin and study of modifying flood control recommendations of report of 10 Dec 1941. No improvements to the main stem were recommended.

Corps of Engineers' small projects studies that have led to construction in the basin are as follows:

a. Simpson Creek, Section 208 Report (Sept 1955)

b. Cowpen Swamp, Section 208 Report (April 1958)

c. Simmons Bay Watershed, Detailed Project Report (Feb 1961)

d. Buck Creek, Detailed Project Report (Oct 1962)

e. Todd Swamp, Section 208 Report (March 1963)

f. Crab Tree Swamp, Section 208 Letter Report (Nov 1964)

g. Gapway Swamp, Section 205 Report (Jan 1966)

Other works which could have a bearing on the findings of this Stage 1 evaluation are as follows:

a. Caw Caw Swamp Watershed, Work Plan, SCS (April 1964)

b. Soules Swamp, Reconnaissance Report, Corps Eng. (June 1969)

c. Report for HUD, Certification for Water and Sewer Functional Planning, Waccamaw Regional Planning and Development Council (May 1972)

d. Flood Plain Information, City of Conway, Corps Eng. (March 1973)

e. Environmental Report, Waccamaw River Project, Coastal Zone Resources Corporation (December 1973)

f. Feasibility Study of Requirements for Main Drainage Canals, Horry Counry, SCS (1975)

g. Land Use Plan, Horry County, Waccamaw Regional Planning and Development Council (May 1976)

h. Waccamaw River Basin Navigability Study, Report 07, Stanley Consultants, (1977)

i. Yadkin-Pee Dee River Basin, Level B Draft Recommended Plan, (April 1981)

EXTENT OF INVESTIGATIONS

PURPOSE

The purpose of this report is to review the water resource and problems of the basin, particularly with respect to flooding at Conway, S. C. and to determine whether detailed survey studies are warranted and, if so, develop a comprehensive plan of work for the formulation and evaluation of detailed plans.

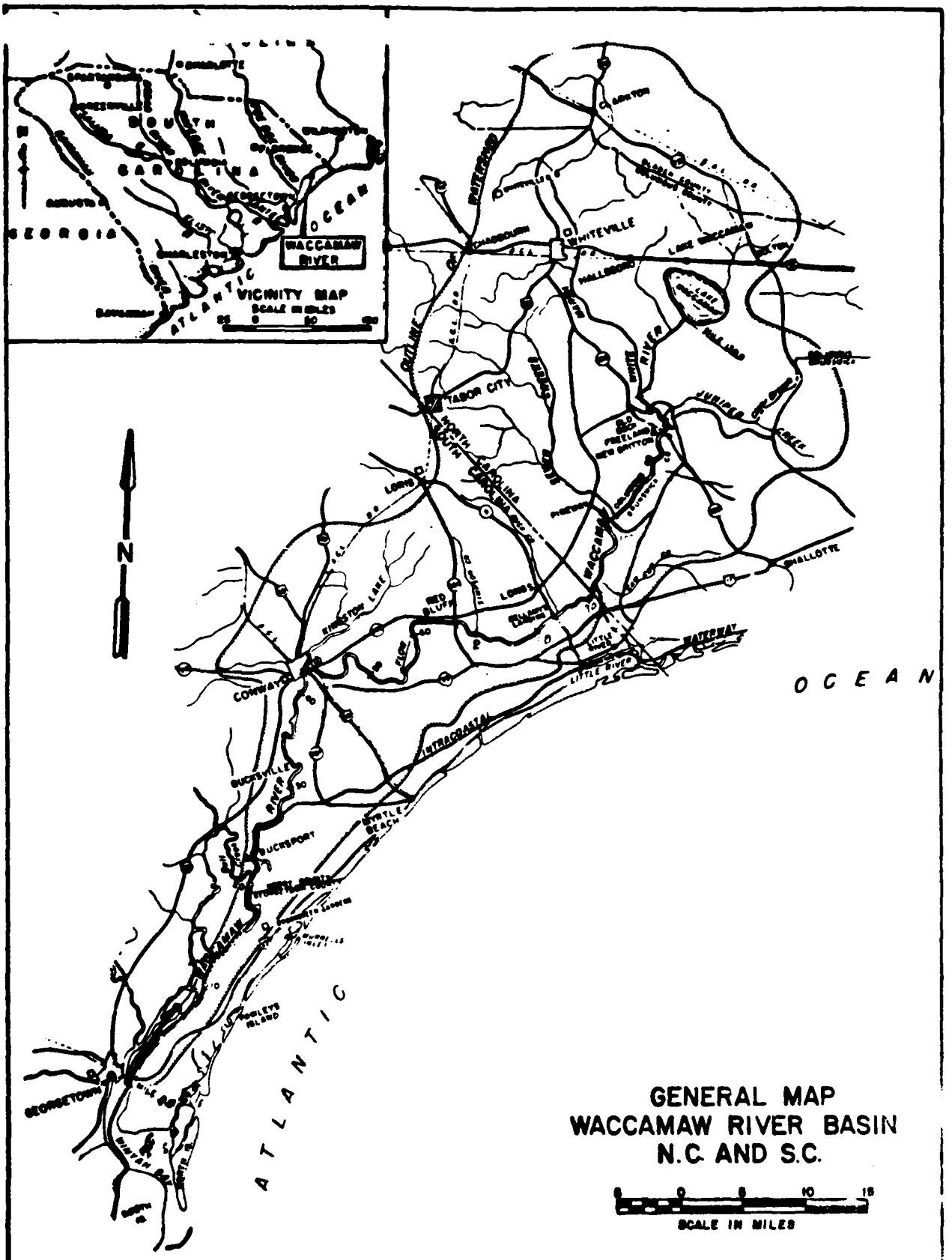
STUDY AREA AND SCOPE OF WORK

Waccamaw River Basin lies entirely in the coastal plain of North Carolina and South Carolina and has a drainage area of 1,530 square miles (see figure 1). The river is a major tributary of the Yadkin-Pee Dee Basin system which encompasses an area of over 18,000 square miles in North Carolina, South Carolina, and a small area in Virginia. Flooding problems, a primary focus area of this study, are intensified by the nearly level topography, moderate soil infiltration rates, and seasonal high water tables. All major tributaries are broad, heavily timbered swamps having nearly flat gradients and no well-defined channels. Urban flood damage occurs at Conway, South Carolina. Residential areas along the river in the vicinity of Conway, such as Lee's Landing, Pitch's Landing, Waccamaw Estates, Bucksville, Bucksport, and Savannah Bluff experience flood damages as often as twice a year. Other flood damage is to crops, pasture, farm improvements, logging operations, roads, and bridges. Most of these damages occur along the major tributaries; however, some damage occurs to woodland growth and reproduction along the main stem.

The evaluations presented in this report are preliminary in nature. Urban flooding was the primary concern of attendees of the 1979 public meeting. Other water resource related problems investigated include: agricultural flooding and drainage, water supply and quality, navigation, hydropower, and recreation.

PUBLIC COORDINATION

Charleston District has the principal responsiblilty for conducting and coordinating this stage of the subject study. Coordination with various Federal, State and local agencies has been maintained. An initial public meeting was held in Conway, S. C. on 10 November 1979, which revealed a strong interest in correcting flooding problems in an environmentally sound way. A summary of this public meeting is presented in Appendix 1.



GENERAL MAP
WACCAMAW RIVER BASIN
N.C. AND S.C.

SCALE IN MILES

CORPS OF ENGINEERS CHARLESTON, S

FIGURE 1

STUDY AREA PROFILE

PHYSIOGRAPHY

Waccamaw River Basin lies entirely in the coastal plain and encompasses parts of Bladen, Columbus and Brunswick counties in North Carolina and Georgetown and Horry counties in South Carolina. It is approximately 161 miles long and 35 miles wide at its widest point, with a total drainage area of 1,530 square miles, of which 580 are in South Carolina and 950 are in North Carolina. About 20 tributary watersheds feed the Waccamaw River with drainage areas ranging from 10 to 300 square miles. The river flows 140 miles generally southwesterly from its source at Lake Waccamaw to Winyah Bay at Georgetown, South Carolina. The course of the river is sluggish, with a wide, flat, swampy flood plain for its entire length. The range of tide at the mouth is 3.2 feet and at Conway, 1.2 feet. Tidal influence is recognized upstream to river mile 82.

Elevations in the basin range from 120 feet above mean sea level (msl) in the upper reaches of the basin to 50 feet msl in the vicinity of the North Carolina-South Carolina state line, and five feet msl near the mouth of the Waccamaw. Topography of the watershed varies from nearly level to gently sloping, with the sloping areas being, for the most part, adjacent to the river flood plain and along the tributaries. The flood plains of the river and many tributaries are broad and flat and subject to frequent and prolonged overflow.

Numerous "Carolina Bays" are found within the basin ranging in size from a few acres to 12,000 acres. The origin of this unique land form is uncertain. These saucer-shaped depressions are a distinctive feature of the landscape affecting drainage and land use. Bays and tidal estuaries are found near the coast at the mouth of the river.

The basin extends across five geological terrace formations which are of marine origin, having been formed by the advancement and recession of the ocean waters at different periods. Soils are nearly all underlain by sands and loamy sands at depths varying from two to five feet. Approximately ten percent of the soils have a medium-to-high organic content in surface layers. Most are highly productive when drained or protected from flooding and are adapted to a wide range of crops.

The climate is characterized by long, warm summers and short, mild winters. Seasonal mean temperatures range from 52 degrees in winter to 79 degrees during the summer. Mean annual rainfall is about 50 inches, with a major portion occurring in the summer and fall.

SOCIO - ECONOMIC CHARACTERISTICS

POPULATION AND LABOR FORCE

During the past decade, the population of the basin has undergone a significant increase, particularly Horry and Brunswick Counties. The Grand Strand area has experienced tremendous increases in development and population. The Myrtle Beach area is not part of the Waccamaw Basin, but it is within 15 miles of Conway's city limits. The Waccamaw Regional Planning and Development Council considers the Grand Strand as an area in Horry and Georgetown counties, bounded by the Waccamaw on the west and the Atlantic on the east. Conway, S. C., the largest city in the basin, boasts a 1980 population of 10,240 and Myrtle Beach and North Myrtle Beach have a premanent population of 22,718 people. All counties located within the basin have areas which lie outside its boundaries. Horry and Columbus are the most populous counties of this predominately rural basin (see Table 1).

TABLE 1
POPULATION OF THE WACCAMAW RIVER BASIN
(1,000)
By Counties

Counties	1970*	1980*	Census of Population & Housing N.C. Prelim. - S. C. Advance % Change 1970-1980	Area of County in Basin %
Horry, S. C.	69,992	101,419	45	48
Georgetown, S. C.	33,500	42,461	27	6
Bladen, N. C.	26,477	30,069	14	14
Brunswick, N. C.	24,223	35,394	46	27
Columbus, N. C.	46,937	51,015	9	71
TOTAL	201,129	260,358	29	

By Incorporated Areas
of 1000 or More

Town/City	1970*	1980*	% Change 1970-1980
Conway, S. C.	8,151	10,240	26
Georgetown, S. C.	10,449	10,144	-3
**Myrtle Beach, S. C.	9,035	18,758	108
**North Myrtle Beach, S. C.	1,957	3,960	102
Tabor City, N. C.	2,400	2,723	13
Whiteville, N. C.	4,195	5,567	33
Bolton, N. C.	534	558	5
Clarkton, N. C.	662	664	0
Chadbourn, N. C.	2,213	1,973	-11
Lake Waccamaw	783	1,085	42

*From U. S. Census Bureau 1980 Census of Population and Housing
**Not within basin boundary

Detailed statistical data concerning the Waccamaw River Basin are not available; however, Waccamaw River is a major tributary of the Pee Dee Basin. Detailed OBERS data are available for the Pee Dee Subarea identified as 0304 and is considered indicative of Waccamaw statistics.

Population of the Pee Dee Water Resource Subarea is expected to increase from 1,842,247 in 1970 to 2,947,300 by the year 2020. This represents a compound growth rate of 0.94% as compared to a predicted compound growth rate of 0.875% for North Carolina and 0.69% for South Carolina. Projected Series E OBERS population figures for the Pee Dee Basin and North and South Carolina are shown in Tables 2 and 3.

TABLE 2

POPULATION

	1970	1980	1990	2000	2020
Pee Dee Basin	1,842,247	2,128,300	2,409,700	2,604,300	2,947,300
North Carolina	5,091,000	5,736,300	6,464,700	6,972,900	7,864,100
South Carolina	2,596,000	2,818,500	3,121,900	3,319,400	3,666,700

The following tabulation shows projected employment/population ratios for the Pee Dee Basin and North and South Carolina. This tabulation was also formulated on 1972 Series E OBERS projections.

TABLE 3

EMPLOYMENT/POPULATION RATIO

	1970	1980	1990	2000	2020
Pee Dee Basin	.41	.45	.45	.46	.45
North Carolina	.41	.45	.45	.46	.45
South Carolina	.43	.47	.47	.48	.47

INCOME PROJECTIONS

Future income estimates are based on 1972 Series E OBERS projections. The per capita personal income projections for 1970-2020 (in 1967 dollars) and the projected relative per capita income (U.S. = 1.00) are shown in the following tabulations.

TABLE 4

INCOME PROJECTIONS

	1970	1980	1990	2000	2020
		Per Capita Income (1967 $)			
Pee Dee Basin	$2,849	$3,900	$5,200	$7,000	$11,600
North Carolina	$2,842	$3,900	$5,100	$6,900	$11 5[illegible]
South Carolina	$2,616	$3,600	$4,800	$6,500	$[illegible]

TABLE 5

Relative Per Capita Income (U.S. = 1.00)

Pee Dee Basin	0.82	0.83	0.85	0.86	0.88
North Carolina	0.82	0.82	0.84	0.85	0.87
South Carolina	0.75	0.77	0.80	0.80	0.84

LAND USE

The Waccamaw River Basin is an agricultural area. The principal crops grown are tobacco, corn, cotton, soybeans, sweet potatoes, and small grain. In some areas production of blueberries, strawberries, and truck farm crops are of importance. Of these, the production of bright leaf tobacco is by far the most important crop grown and is the economic mainstay of the basin. Farming is found almost entirely in tributary areas, with the exception of approximately 1000 acres in the flood plain of the main stem. Pasture and grazing and production of hay and silage crops for livestock are relatively minor as compared to cultivated crops. The production of timber, pulpwood, and veneer logs is also an important land use. Timber is grown and harvested extensively in the basin. Because of the flood threat and drainage problems, the main stem flood plain of the Waccamaw River is devoted almost entirely to this use. Mineral production in the basin is insignificant.

NATURAL AND CULTURAL RESOURCES

These resources may best be understood through the reading of the Planning-Aid Report prepared by the U.S. Fish and Wildlife Service. This report appears in its entirety in Appendix 2.

PROJECTED CHANGES

The entire study area, particularly Horry County, S. C., is expected to experience considerable economic growth as a result of migration to sunbelt areas in close proximity to the coast. The Grand Strand area experiences population surges of more than 500% during tourist months

May through September. More than 350,000 are expected to cram the Grand Strand beaches during July 4 and Labor Day weekends. Parts of Georgetown County in S.C. and Brunswick County in N.C. are also within short driving distances to ocean recreation and can be expected to grow dramatically in the future as land in coastal areas is developed. The areas with greatest potential for growth are within 25 miles of the ocean.

It is difficult to predict industrial growth in the Waccamaw Basin. Georgetown, S.C. is the major industrial area with many industrial workers living within the confines of the basin. The mainstays of the basin are agriculture and timber production but geographical expansion and extension of the Grand Strand tourist season to a year-round attraction has tremendously increased the economic base of the Waccamaw Region.

PROBLEMS

Urban flooding along the main stem of the Waccamaw River was the problem most frequently identified by those attending the 1979 public meeting. Various other flooding problems within the basin include: agricultrual flooding along the main stem, and tributary flooding and drainage affecting agricultural, timber, residential and commercial property.

URBAN FLOODING

Flooding problems have plagued residential areas around Conway for many years. The September 1928 flood brought flood waters more than six feet above flood stage, however, shallow flooding as often as twice yearly is not uncommon. Urban flooding is compounded by the Waccamaw's flat gradient and the backwater effects from the Great Pee Dee and Little Pee Dee Rivers which contribute to the extremely slow downstream movement of flood waters. Flood stage usually lasts from a few days to 4 or 5 weeks depending upon antecedent moisture conditions and the intensity and duration of rainfall throughout the area.

The City of Whiteville, North Carolina, often experiences flooding in the southern part of town adjacent to Soules Swamp. The business district experiences some flooding problems as often as twice yearly; however, this is not due to the overflow of the swamp but is from the inability of storm drains to convey direct runoff to the receiving stream.

AGRICULTURAL FLOODING AND DRAINAGE

Agricultural flooding occurs primarily in the tributary watersheds. About 1000 acres of cultivated and pasture land and 50,000 acres of woodlands sustain damage from main stem flooding. Main stem agricultural flooding reaches from Conway to Lake Waccamaw; however, agricultural and timber production along the main stem is not expected to increase significantly in the future.

There are 17 tributary watersheds, averaging 79 square miles each, that have improvement potential for agricultural purposes. See Plate 1. Tributaries throughout the basin are overgrown and choked with sediment, debris and vegetation. Careless timber operations, poor agricultural practices, construction runoff, and lack of adequate channel maintenance programs have resulted in progressive aggradation of the stream beds and flooding of the surrounding level lands to form swamps. The inability to properly drain formerly productive cropland and the long periods of inundation after floods have caused a gradual abandonment of cropland, pasture, and woodland adjacent to swamps of freshwater marshes.

Flood prevention and drainage problems of agricultural (Crop & Timber) land is summarized in Table 6.

TABLE 6

*Conservation Needs Inventory

State	Problems	Acres Having Problems (1000Ac)
North Carolina	Flood Prevention	204
South Carolina	Flood Prevention	197
Total		401
North Carolina	Drainage	400
South Carolina	Drainage	164
Total		564

From information given in the above table, it can be seen that over half of the Waccamaw Basin's 979,000 acres experiences flooding and drainage related problems.

County highways throughout the basin are flooded frequently after rains of moderate intensity and duration, and remain waterlogged for extended periods. The elevation of stream beds is so high that highway ditches have insufficient slope to drain the roads. Even after prolonged droughts, some of the dirt roads are nearly impassable because water from overflowing ditches forms ponds on the traveled way. Frequently, school buses are unable to complete their schedules, rural mail carriers are unable to make deliveries, and area citizens are unable to come and go for days at a time after ordinary rainstorms.

WATER SUPPLY

At the present time, the only known use of water from the Waccamaw River is for cooling purposes in connection with the power plant at Conway, S. C. There is also very limited use of water from some of the principal tributaries for irrigation purposes. Suitable reservoir sites to regulate the flow of the river are not available. Tidal influence, which affects the quality of water during low flows, is another factor limiting the use of river water from Conway downstream.

Water supplies for urban areas, communities and industrial uses are primarily supplied by high yield wells. Well yields of 75 to 400 gallons

*Source - Conservation Needs Inventory, Soil Conservation Service (1966-1967)

per minute at depths ranging from 125 to 400 feet are prevalent throughout the basin. Artesian conditions exist in most of these deep wells.

Ground water systems needing greater capacity by year 2010 as taken from the Yadkin-Pee Dee Level B Preliminary Draft (April 1981) are shown in Table 7.

TABLE 7

Groundwater Supply Systems Needing Additional Capacity

High Priority - Capacity Exceeded by 1990

Brunswick County Water System (Brunswick Co.)

*Ocean Isle Beach (Brunswick Co.)

*North Myrtle Beach (Horry Co.)

Medium Priority - Capacity Exceeded by 2000

*Myrtle Beach (Horry Co.)

*Surfside Beach (Horry Co.)

Bucksport W. D. (Horry Co.)

Low Priority - Capacity Exceeded by 2010

Whiteville (Columbus Co.)

*Outside of actual watershed boundary

Drinking water quality, as well as quantity, is of great concern. Communities are confronted with the problems of treating unacceptable levels of fluoride, iron and other chemical constituents commonly found in the area's ground water. Considering the Grand Strand Area's, recent phenomenal growth and summer recreational peak water supply demands, severe water supply problems exist in the basin and contiguous areas.

WATER QUALITY

The Waccamaw River from highway 904 in North Carolina to the state line is classified by NCDNRCD as "B-swamp". Best usage of Class B waters is bathing, fishing, boating, and any other usage except as a source of water supply for drinking, culinary or food processing purposes. Most water above highway 904 is classified as "C-swamp" which is considered very similar to "B-swamp" but not recommended for bathing.

In South Carolina the Waccamaw River is classified as Class A (swamp) from the state line to Conway and Class A from Conway to Winyah Bay. Class A waters should be suitable for primary contact recreation, sources of drinking water (after conventional treatment), fishing, and survival and propagation of fish, fauna and flora. Where swamp waters naturally color streams, add organic matter, and alter PH oxygen, special standards are set to acknowledge the natural conditions.

Throughout the Waccamaw Basin, numerous violations have been recorded for the fecal coliform and dissolved oxygen standards. Most of the contravention of standards in South Carolina were recorded near discharges at Conway; however, several violations appear to have resulted from discharges in North Carolina.

Although sedimentation is generally considered a physical problem rather than a water quality problem, non-point sedimentation is identified as a major pollutant of the Waccamaw Basin. Generally, sediment pollution originates from agricultural lands and construction sites. Other sources of sediment or chemical pollutants are urban storm water runoff, leaking sewers and waste dumps in close proximity to the river. Some of the obvious impacts of non-point source pollution include damage to stream biota, dredging costs, increased treatment costs, and impaired recreational use.

NAVIGATION

The Waccamaw River is presently classified as a "navigable water of the U.S." between its mouth at Winyah Bay near Georgetown, South Carolina to Lake Waccamaw (RM. 140) in Columbus County, North Carolina. The recommended practical limit of navigation is at (RM. 129.5). Minor channel and bridge improvements would be required for commercial navigation up to this point. According to local residents, during periods of low flow, the river could scarcely be navigated by small recreational fishing boats above (RM 76.0).

The Waccamaw River is currently being used for purposes of waterborne interstate commerce. Commodities transported consist of shellfish, logs, and jet fuel. Red Bluff (RM. 70) is described as the limit of actual commercial navigation; however, most commercial traffic uses only that part of the river that comprises a link of the Atlantic Intracoastal Waterway (RM. 0.0 to RM. 28.0).

No indications of serious navigation problems presently exist in North Carolina. There is no commercial navigation on the main stem of the Waccamaw above Conway, and none is contemplated. Stilley Plywood Co., which formerly barged wood products from above Conway to Georgetown, now utilizes trucking almost exclusively. The use of the Waccamaw River and its tributaries for interstate commerce is difficult to predict due to limited industrial and commercial activity and heavy dependence on land transportation systems. Future potential waterborne commerce could be significant because of its established interstate commerce history, its location near the coast, and the confluence at Winyah Bay with other major tributaries of the Yadkin-Pee Dee Basin.

HYDROPOWER

Hydroelectric power development in the Waccamaw is not feasible at the present time due to the lack of suitable reservoir sites, highly variable stream flow characteristics and lack of hydrostatic head for generating capacity.

RECREATION

Many people expressed a desire that no changes be made in the river's present characteristics other than minor clearing and snagging and some dredging of sandbars along the main stem. Many of those who have recently located in flood prone areas and long time residents have done so to enjoy the quiet solitude and wilderness atmosphere that much of the Waccamaw River offers. Both states and the Federal Government have programs that provide environmental protection and preservation of sites and streams. Table 8 lists areas in the basin reported in the Yadkin-Pee Dee Preliminary Draft (April 1981) as having potential for inclusion in special designation programs.

TABLE 8

AREAS WITH POTENTIAL FOR SPECIAL ENVIRONMENTAL DESIGNATION

*Brown Marsh-Elkton Swamp	NC Natural Area	Bladen
White Marsh	NC Natural Area	Columbus
*Waccamaw Lake	NC Natural Area	Columbus
Waccamaw River	Nat'l Wild & Scenic River	Brunswick, Columbus
Waccamaw River	NC Natural/Scenic River	Brunswick, Columbus
Waccamaw River	Nat'l Wild & Scenic River	Georgetown, Horry

*Areas with highest potential or priority for special designation.

During dry periods the water in parts of the river above mile 76 is less than one foot deep. It has been suggested recently by residents and businessmen of the area that rubble weirs be placed across the upper reaches of the river to provide habitat for fishery resources and to enhance small boat navigation during low flow periods. Structures such as these would be counter productive creating silt traps, obstructions to navigation, and flow obstructions. Locals must recognize that every stream cannot be fished and navigated to the satisfaction of everyone. Use made of the stream should be compatible with the resource rather than trying to modify the resource to satisfy desired usage.

STUDY OBJECTIVES

Following the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources" and the needs and problems identified in the previous section, the following planning objectives were defined for the Waccamaw River Basin Survey Investigation:

Reduce urban flood damages along the Waccamaw at Conway, S. C.

Reduce agricultural losses and increase productivity near tributaries that experience flooding and drainage deficiencies.

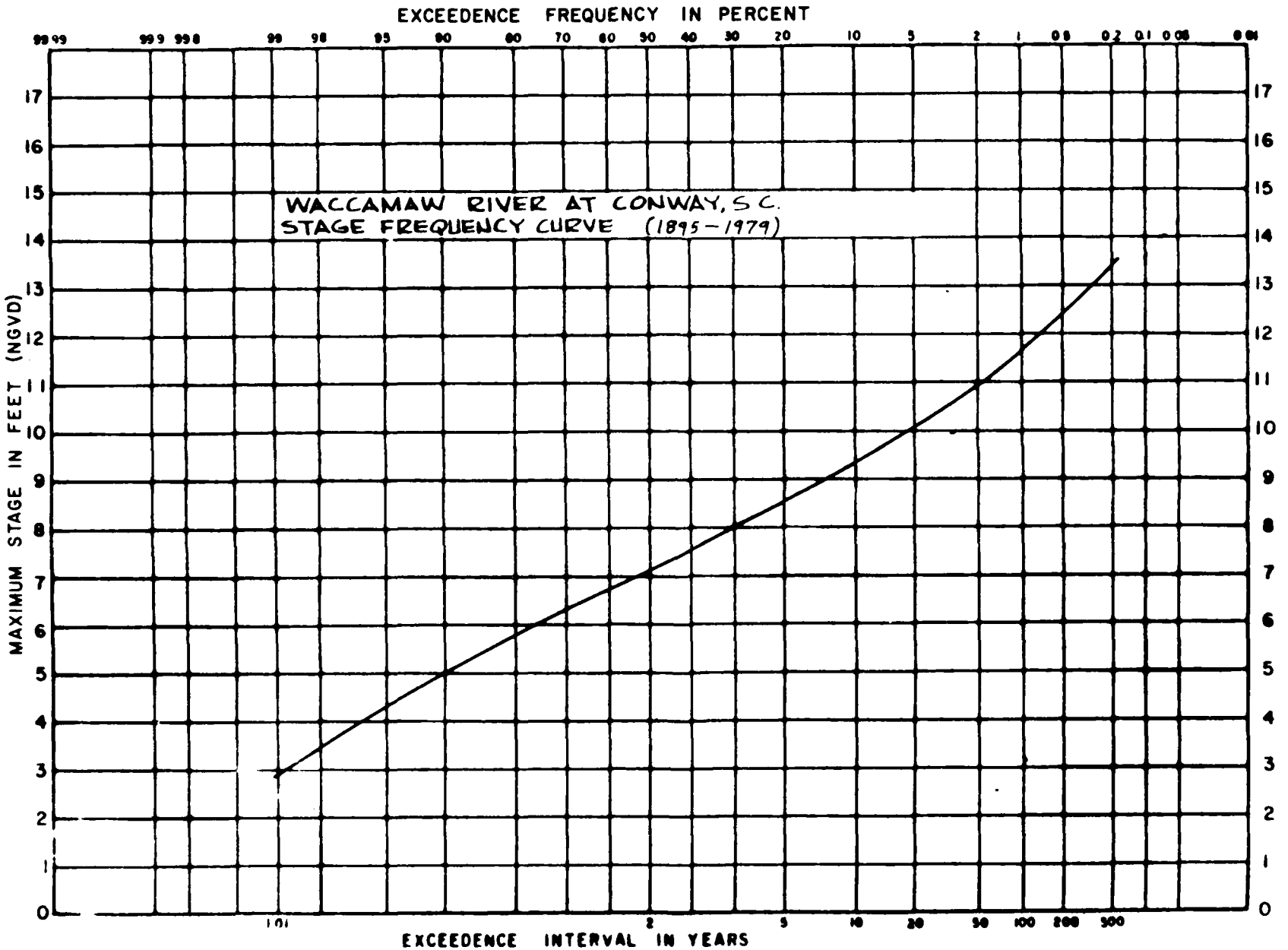
Improve recreational boating opportunities in the upper reaches of the river.

Provide for the conservation of existing wetlands and critical wildlife habitats in the study area.

Study possiblilities to provide surface water supply to potential water shortage areas.

HYDROLOGIC AND HYDRAULIC ANALYSIS

The hydrology for this report consists primarily of updated information that was provided in the 1966 survey report. River gaging station data at Freeland, N. C. and Conway, S. C. was updated from the latest available NOAA and USGS information and reanalyzed. (Figures 2 to 5). Stage and discharge-frequency analysis of the Longs, S. C. gage was completed using USGS data since 1951. (Figure 6 and 7).


EXCEEDENCE FREQUENCY IN PERCENT
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
WACCAMAW RIVER AT CONWAY, S.C.
STAGE FREQUENCY CURVE (1895-1979)
MAXIMUM STAGE IN FEET (NGVD)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
1.01 2 5 10 20 50 100 200 500
EXCEEDENCE INTERVAL IN YEARS

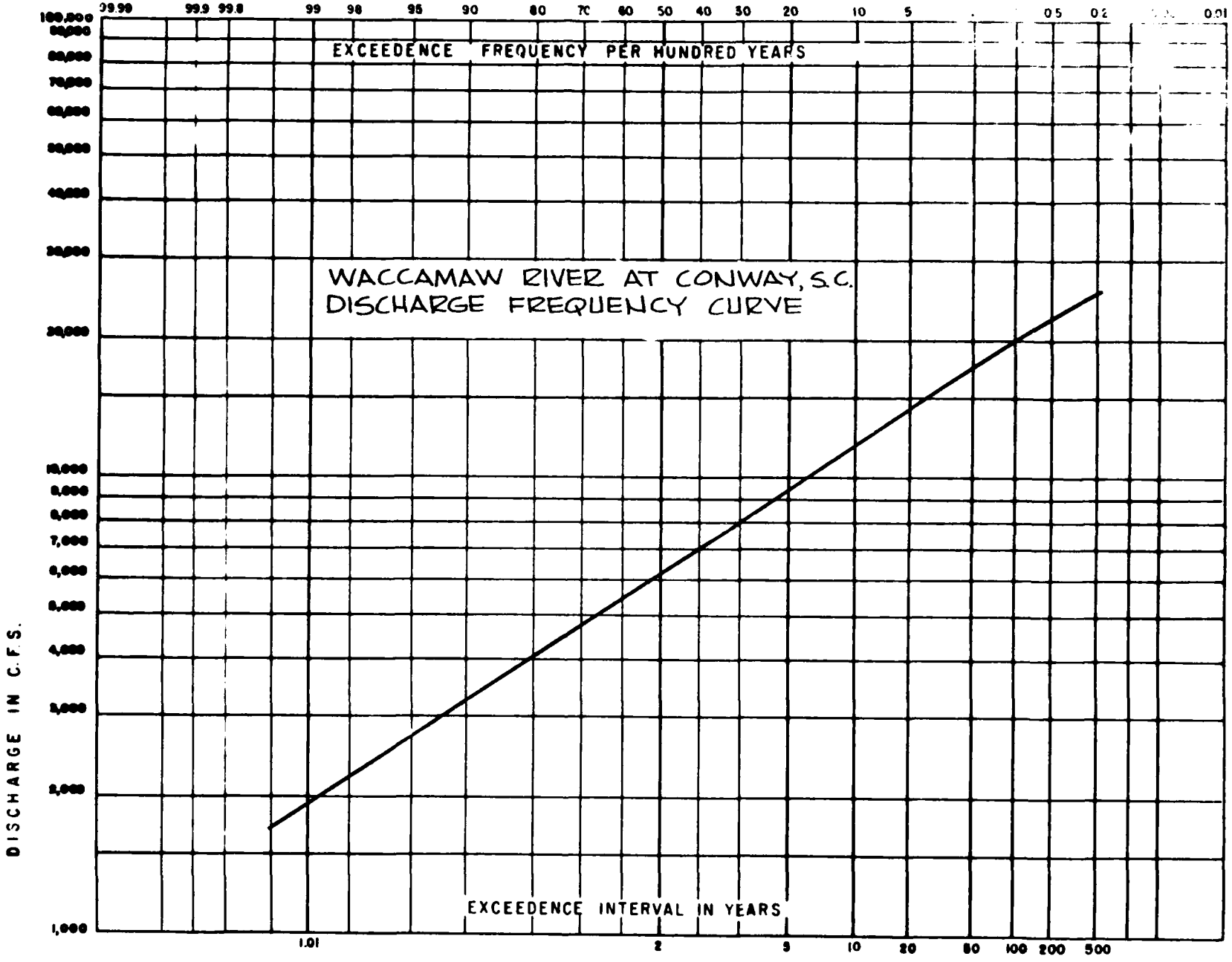

WACCAMAW RIVER AT CONWAY, S.C.
DISCHARGE FREQUENCY CURVE
EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 .5 .2 .01
DISCHARGE IN C.F.S.
100,000
50,000
40,000
30,000
20,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
EXCEEDENCE INTERVAL IN YEARS
1.01 2 5 10 20 50 100 200 500

FIG 3

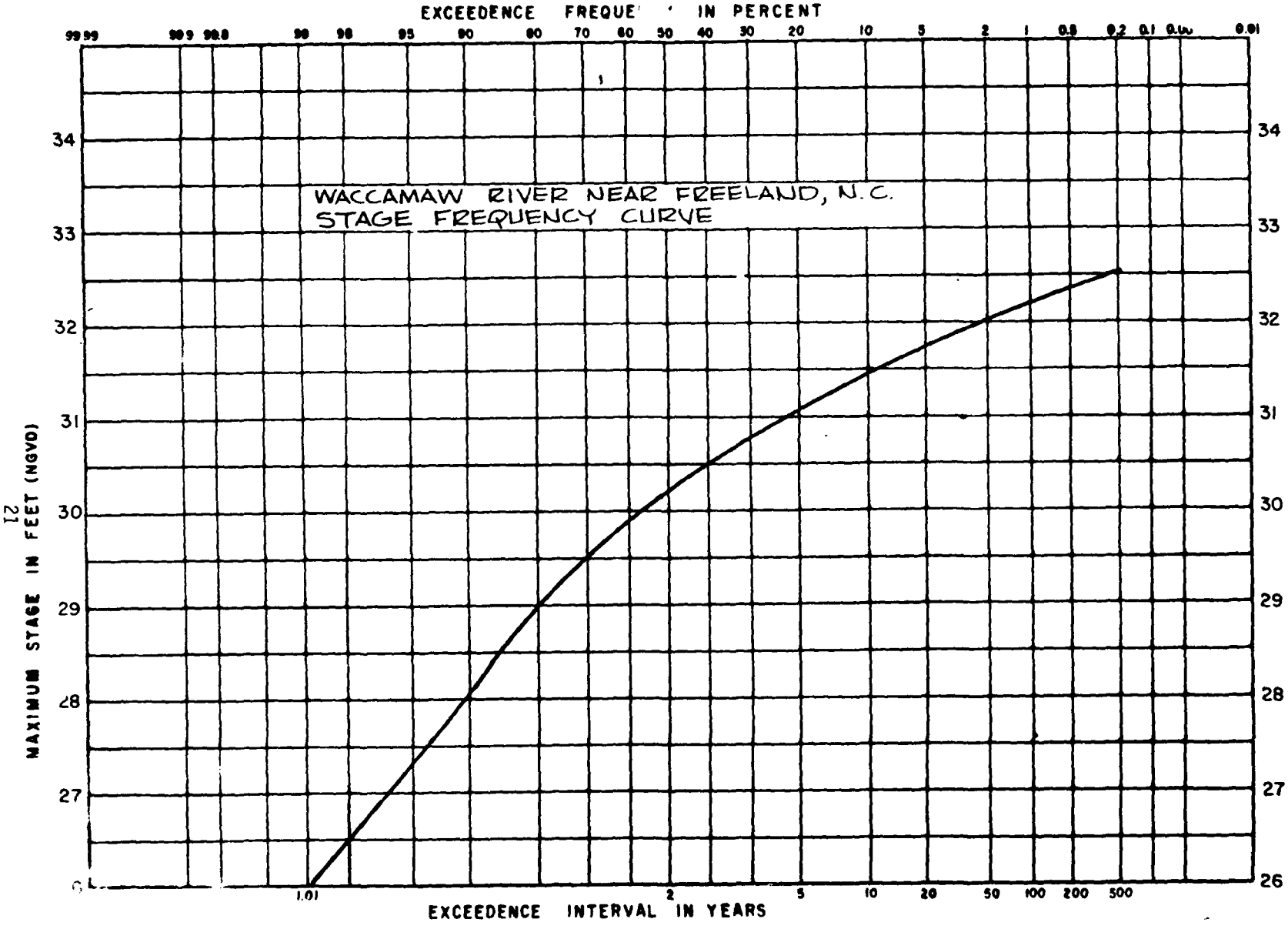

EXCEEDENCE FREQUE ' IN PERCENT
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
WACCAMAW RIVER NEAR FREELAND, N.C.
STAGE FREQUENCY CURVE
MAXIMUM STAGE IN FEET (NGVD)
34 33 32 31 30 29 28 27 26
1.01 2 5 10 20 50 100 200 500
EXCEEDENCE INTERVAL IN YEARS

FIG 4

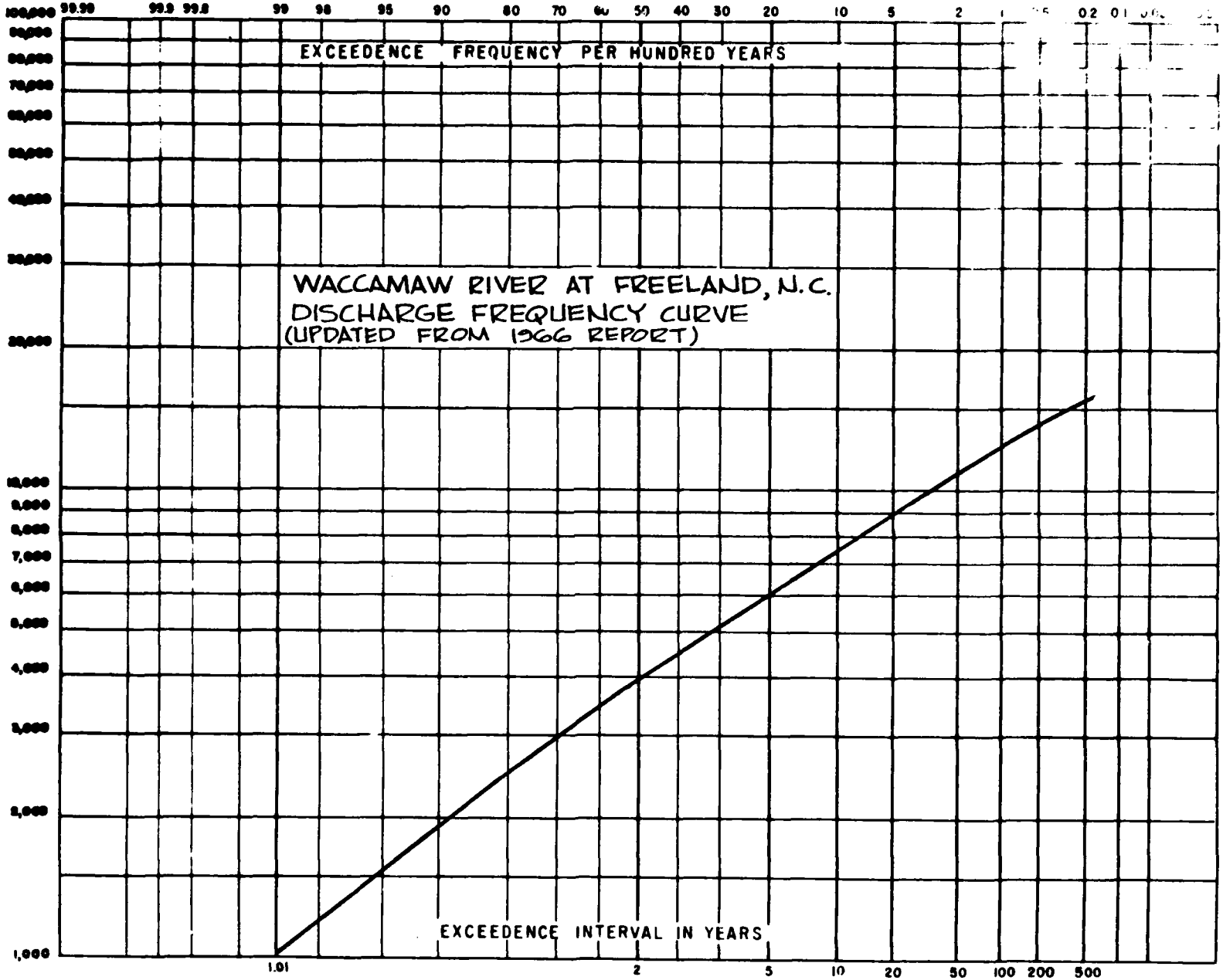

EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.99
99.9
99.8
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
.5
.2
.1
.05
WACCAMAW RIVER AT FREELAND, N.C.
DISCHARGE FREQUENCY CURVE
(UPDATED FROM 1966 REPORT)
DISCHARGE IN C.F.S.
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
EXCEEDENCE INTERVAL IN YEARS
1.01
2
5
10
20
50
100
200
500

Fig. 5

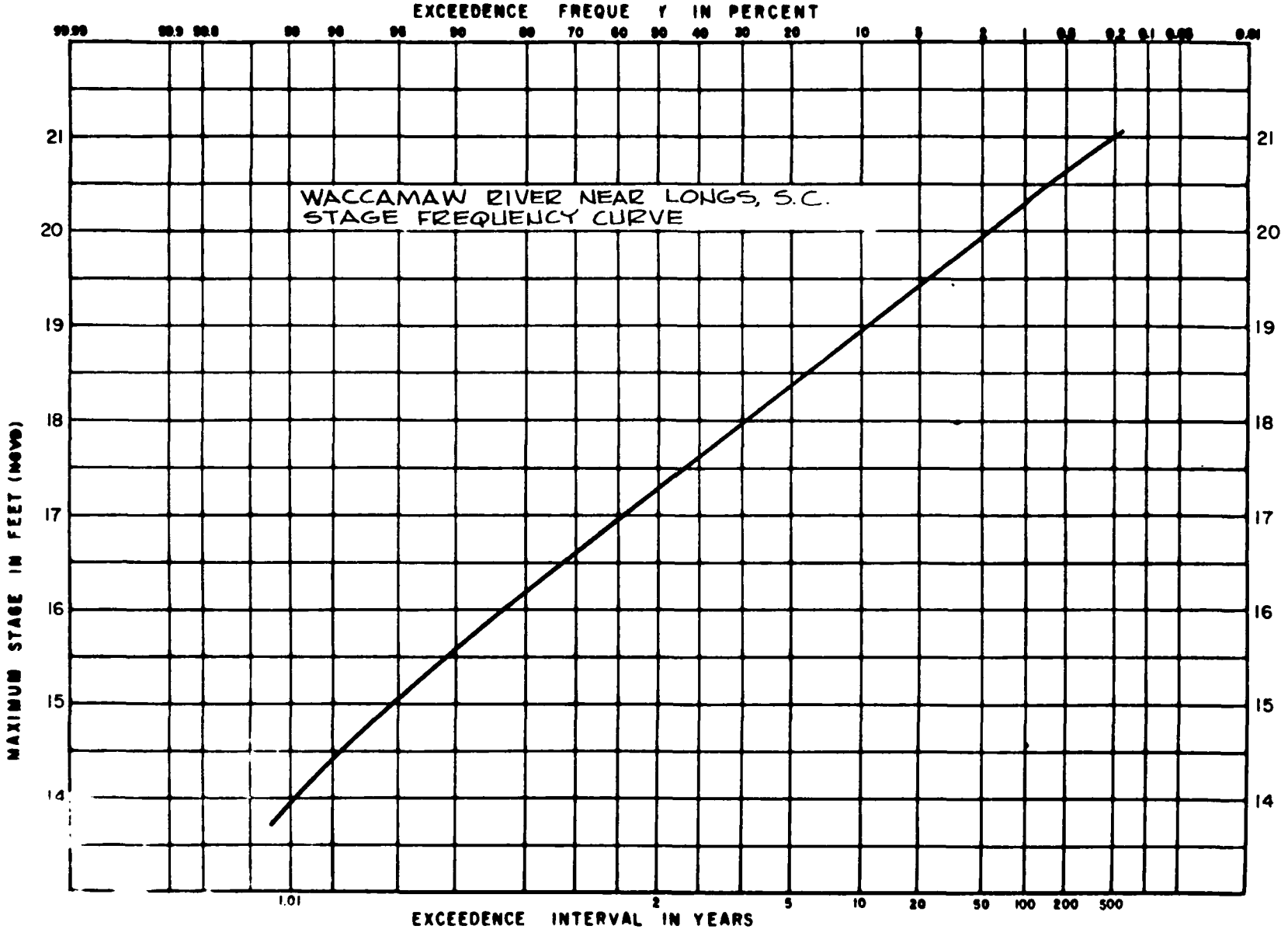

EXCEEDENCE FREQUE Y IN PERCENT
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
WACCAMAW RIVER NEAR LONGS, S.C.
STAGE FREQUENCY CURVE
MAXIMUM STAGE IN FEET (NGVD)
21
20
19
18
17
16
15
14
1.01
2
5
10
20
50
100
200
500
EXCEEDENCE INTERVAL IN YEARS

Fig. 6

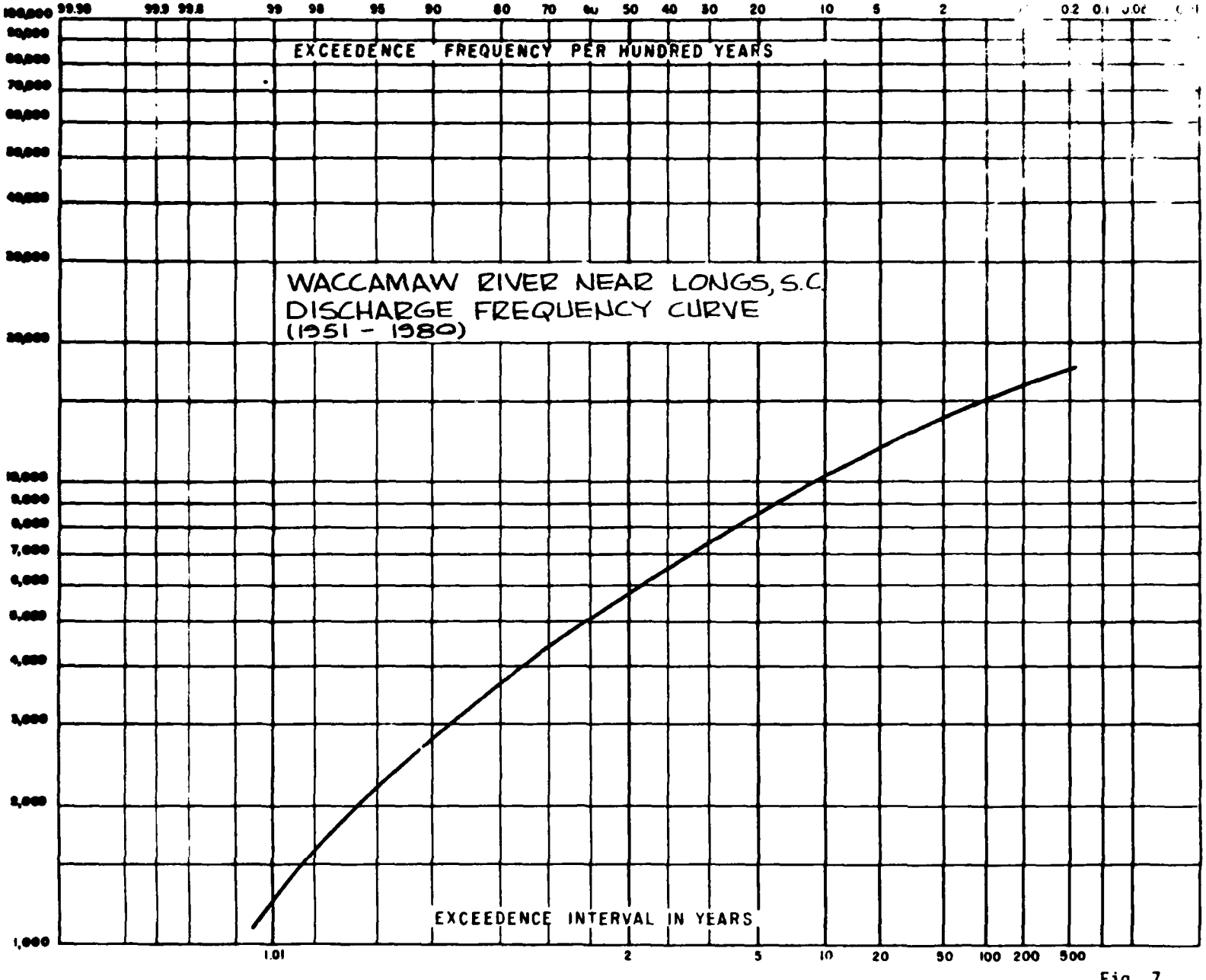

EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.99
99.9
99.8
99
98
95
90
80
70
60
50
40
30
20
10
5
2
0.2
0.1
WACCAMAW RIVER NEAR LONGS, S.C.
DISCHARGE FREQUENCY CURVE
(1951 - 1980)
DISCHARGE IN C.F.S.
1,000
2,000
4,000
7,000
EXCEEDENCE INTERVAL IN YEARS
1.01
2
5
10
20
50
100
200
500

Fig. 7

PRELIMINARY PLANS OF IMPROVEMENTS

A wide range of institutional and technical measures exist for improving the management of water and related land resources in the study area. They have been identified and analyzed in general terms to determine the extent to which they might contribute to the planning objectives of this study. The various measures considered are described in the following paragraphs.

FLOOD PLAIN REGULATIONS

Flood hazards in the basin have been identified for some of the urban areas under the Flood Plain Management Program and under the National Flood Insurance Program (NFIP). This information would allow the local governments for which the information was compiled to develop and enact ordinances which would restrict obstructive development in floodway areas and control development in fringe area to avoid damage to a given frequency level.

Flood plain use regulations, if enforced properly, will help in controlling flood damage to future development. Flood plain regulations have positive contributions to flood control planning objectives.

UPSTREAM STORM WATER MANAGEMENT

Availability of undeveloped lands, topography, characteristics of storms make the traditional temporary storage method impractical.

A less traditional method than local ponding and major reservoirs, which would fit this class of treatment, would be a diversion of upper basin flows to the Atlantic Ocean via Little River Inlet. Such an effort would be engineeringly feasible but would have significant economic and environmental draw-backs. Benefits of the diversion canal attributable to reduction of damages to residential and commercial properties would be only half of the computed annual cost of $755,000.

FLOOD INSURANCE

The National Flood Insurance Program (NFIP) is administered by the Federal Insurance Administration (FIA), part of the Federal Emergency Management Agency (FEMA). FIA has prepared and furnished flood insurance studies to the appropriate officials in the City of Conway and Horry County (these areas which were reported to have the most critical urban flooding problems). These studies should have a significant impact through the provision of information basic to the adoption and enforcement of flood plain management ordinances.

Flood plain residents are eligible for subsidized insurance on their principal residence and on the contents of their home. Additional coverage for the structure and contents is available at actuarial rates. All new construction of substantial improvements are eligible for flood insurance at actuarial rates. A minimum insurance policy is available at low cost and can cover both the structure and contents. Flood insurance is obtained through private insurance agencies. Though the measure is voluntary, it should be considered under both "with" and "without" project conditions.

TEMPORARY FLOOD PLAIN EVACUATION

Temporary evacuation of persons and personal property from flood prone areas could be accomplished when a flood threat exists. Temporary evacuation can be very effective when operated in conjunction with a reliable flood forecasting system. It might help considerably in avoiding risk to lives; however, since most of the property subject to flooding is inmobile, there still would be considerable economic losses. The measure would also require that facilities to carry out the evacuation plan be substantially improved. Since the risk to losses of lives in the urbanizations adjacent to the river channel homes is relatively high, this measure should be considered under all those plans that permit water to flow through those areas.

PERMANENT FLOOD PLAIN EVACUATION

Permanent evacuation of flood plain areas could be used to reduce flood damage potential. Such a measure would involve land purchase, physical removal of buildings and improvements, and relocation of population. Lands acquired in this manner could be used for parks or other purposes that would not interfere with flood flows or result

in material damages and the anxiety and other inconveniences associated with flooding. Additionally, the flood plain area would convert to green space which would have beneficial impacts on aesthetics, recreation potential, and wildlife habitat. This measure should be strongly emphasized as a component of the plains.

FLOOD PROOFING

Flood proofing methods would also be studied for the residential sectors, industrial areas, and public office buildings. They serve to reduce or eliminate flood losses. These methods are primarily structural changes and adjustments which allow flood waters to rise around or within a building with little or no damaging effects to the building. However, flood proofing techniques do not eliminate residual nuisance damages, loss of access, loss of business, possible utility and community interruptions, and potential dangers to public health and safety.

The primary approach to flood proofing would be to protect structures by excluding flood waters from entering. This involves installing gate valves in drain and sanitary sewers, installing gates and covers in doorways and windows, and sealing with a waterproof coating exterior surfaces to prevent penetration by flood water. Building dikes and protective walls around structures and constructing a second floor to the residential structures are other techniques which would be investigated.

CHANNEL MODIFICATION

Channel modification involves widening and straightening in order to improve the hydraulic carrying capacity of the channel. Channel modification and floodways are expected to lower flood heights and result in significant long term flood damage reduction, increased property values, and enhance the security and general welfare of flood plain residents. Associated health problems experienced during flooding are either eliminated or reduced. Additionally, channel modification would reduce the anxiety associated with unexpected flood occurrences and the inconveniences associated with temporary disruption of employment, isolation, community services, transportation, utilities, and other community amenities and services. Channel modification would also reduce temporary isolation of residents during flooding and permanent relocation of flood plain residents. On the other hand, channel modifications will disrupt the aquatic biota along the streams. Also such measures would require considerable resource

uring construction and maintenance. The measure of channel modification would contribute significantly to the flood control objectives.

FLOODWALLS AND LEVEES

This type of measure precludes flood waters from entering damage susceptible areas. Their adverse and beneficial impacts are similar to those of channel improvements. They are not considered in detail because of the linear type of development employed in the damage areas.

DO NOTHING (NO ACTION PLAN)

The "Do Nothing" alternative preceives the continuation of existing conditions and no new solution for existing problems. This option, although not favored by local study sponsors, avoids both the monetary investment and potential adverse impacts associated with structural improvements. However, potential loss of life and personal and real property would remain. The "Do Nothing" plan provides a basis for evaluating the impacts of other plans.

SUMMARY OF ALTERNATIVES

Relative outputs of the initial list of alternatives in terms of the planning objectives and their contribution to the four accounts in the principles and standards are displayed in Table 9.

TABLE 9
STAGE 1 ALTERNATIVES AND ACHIEVEMENTS

Alternatives	Planning Objectives[1/]						Principles & Standards[2/]			
Non-Structural	UFC	AFC	WS	RB	WP	PS	NED	EQ	OSE	RED
1. Permanent Flood Plain Evacuation	P	P	-	-	P	P	P	P	P	P
2. Temporary Flood Plain Evacuation	P	P	-	-	-	P	P	P	P	P
3. Flood Insurance	P	P	-	-	P	P	P	P	P	P
4. Regulation of Flood Plain	P	P	-	-	P	P	P	P	P	P
5. Flood Proof Structures	P	P	-	-	-	P	P	P	P	P
6. Do Nothing (No Action)	-	-	-	-	-	-	-	-	-	-
Structural										
1. Upstream Storm Water Management	P	-	F	-	-	P	-	-	-	-
2. Channel Modification	P	P	-	P	-	P	P	-	P	P
3. Floodwalls and Levees	P	P	-	-	-	P	-	-	-	-

1/ UFC = Urban flood control
AFC = Agricultural flood control and drainage
WS = Water supply
RB = Recreational boating
WP = Wetland and environmental resource protection
PS = Public safety

Cod : F = Meet fully
P = Meet Partially
- = Does not address

2/ NED = National economic development
EQ = Environmental quality
OSE = Other social effects
RED = Regional economic development

PRELIMINARY PLAN

Considering the nature of problems and the land, water and environmental resources of the basin, it is apparent that solutions would be best developed at the local level. With flood control reservoirs being out of the question, it is apparent that water supply cannot be worked in as a purpose in a multi-purpose solution. Current legislation would not allow this to be addressed as a single purpose objective. Classed as "single purpose", water supply problems remain the responsibility of local governments. The worst problem, that at Myrtle Beach, appears to be near resolution with a plan to withdraw water from the Atlantic Intracoastal Waterway.

Two local problems will be looked at to determine the Federal interest in continuing feasibility planning. These problems are urban flooding at Conway and agricultural flooding in the Brown-Grier watershed.

URBAN FLOOD CONTROL - CONWAY, S. C.

a. Features. With approximately 200 residents found in linear clusters spotted in the flood plain in the vicinity of Conway, permanent evacuation (demolition) would provide a viable means of addressing flooding problems. Removal of residence from the two- four- and eight-year frequency flood plains was considered. Optimism of the demolition plan occurred at the four-year frequency level. The plan therefore would result in the demolition of 21 residences from six separate localities. A few structures may have been overlooked during the field and map evaluations done for this reconnaissance appraisal. A map showing the location of the six locations is given as Plate 1.

The affected structures would be purchased at fair market value (including the purchase of related lands and improvements). Residences and other improvements would either be relocated or demolished depending on the type and condition of the structure and the availability of relocation sites. Actual implementation of the plan would likely result in a combination of relocations and demolitions. For purpose of this evaluation, it is assumed that all affected structures would be demolished.

b. Cost Estimates. Cost estimates are based upon windshield appraisals of properties and tax records. Not included in the feasibility determinations are costs that would be incurred for the relocation of families under "The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970". This is Public Law 91-646 which would be applicable for all relocation activities.

Costs were analyzed using an interest rate of 7-3/8 percent over a period of 50 years. A summary of costs and benefits is given in Table 10.

c. Economic Outputs. The plan would address three of the planning objectives: urban flood control, wetland and environmental resource protection, and public safety. Outputs measurable in monetary terms would be as shown in Table 10.

TABLE 10

URBAN FLOOD CONTROL PLAN FOR
CONWAY, S. C. AREA

Annual Value in $1,000

Flood Plain Evaluated	Damage	Benefits	Cost	Net Benefits	B/C Ratio	No. of Str. Affected
Total	505					
2 Year	443	51.33	33.78	17.55	1.52	10
4 Year	371	115.25	89.46	25.79	1.29	21
8 Year	202	263.58	257.12	6.46	1.03	66

d. Viability. The plan evaluated appears to be an economically feasible and environmentally sound approach for addressing some of the study objectives. This is indicated by a benefit-to-cost ratio in excess of unity. Implementation of the plan would create opportunities to restore the land vacated to its natural condition for wildlife habitat. Another option for use of the land would be

for public recreation compatible with and protective of adjacent ecosystems. Another area that should bear on later investment decisions is the probability that, if nothing is done, there will be losses in human lives, as well as suffering that accompanies such losses.

AGRICULTURAL FLOOD CONTROL

BROWN - GRIER CREEK WATERSHED

Since the size of the Waccamaw River Basin precludes in depth analysis of all the agricultural flooding and drainage problems during the first stage of study, a small area was selected for analysis as an indicator of Federal interest in addressing this type of problem. The area selected (see Plate 2) is the watershed of Brown and Grier Creeks which is 9,500 acres in size. Approximately one-third of the area is utilized for crop production, and the remainder is woodland or is in non-farm use. Of the 3,200 acres of cultivated land, 2,470 acres have flooding and drainage problems. Corn and soybeans are the principle crops in the watershed.

a. Features. The plan to decrease flooding and drainage losses would be the upgrading of a system of ditches and streams. Bottom widths would vary from three to 14 feet. A total of 17.42 miles of channelization would be required in the plan.

b. Cost Estimates. Estimates of first and annual costs are given in Table 11. Annual costs are based on a 7-3/8 percent discount rate and a project life of 25 years.

TABLE 11

COST ESTIMATE FOR CHANNELIZATION

OF BROWN - GRIER WATERSHED

First Costs

Land	95 acres @ $750/acre	$ 71,000
Clearing	82 acres @ $1,000/acre	82,000
Excuvation	140,000 yd. 3@ $1.40/yd^3	195,000
Culverts	L.S.	10,100
Grassing	45 acres @ $1,000/acre	45,000
SUB TOTAL		$ 322,200
Government Cost	S&A and E&D	75,000
Contingencies		48,300
TOTAL FIRST COST		$445,500

ANNUAL COSTS

Interest and Amortization	$ 39,529
O and M Costs	1,700
AVERAGE ANNUAL COST	$ 41,229
SAY	41,300

c. *Economic Outputs.* The plan would address one of the stated planning objectives. This agricultural flood control and drainage objective, however, is not ranked very highly by the present national administration. Outputs measurable in monetary terms would be as shown in Table 12. Annual benefits expected from the plan would be the difference between "With Project Conditions" and "Without Project Conditions". These amount to $52,300 per year. Even with the project in place, annual damages of about $15,200 would be experienced.

TABLE 12

Agricultural Returns
(1980 Current Normalized Prices)

Soil Type	Acreage by Crop		Bushel/Acre		(in dollars)		(in dollars)		
	Corn	Soybeans	Corn	Soybeans	Corn	Soybeans	Corn	Soybeans	Combined
			Without	Project	Conditions				
Yauhannah	62	72	80	25	6.75	34.00	419	2448	2867
Meggett	183	214	75	25	1.5	34.00	275	7276	7551
Witherbee	64	76	60	20	-12.25	15.00	-784	1140	356
Eulonia	810	951	70	20	-3.50	15.00	-2835	14265	11430
Eunola	17	21	70	20	-3.50	15.00	-60	315	255
Total/Average	1136	1334	70	21	-2.63	19.07	-2985	25444	22459
			With	Project	Conditions				
Yauhannah			110	35	44.56	48.56	2763	3496	6259
Meggett			95	35	22.06	48.56	4037	10392	14429
Witherbee			70	25	-8.19	29.56	-524	2247	1723
Eulonia			90	30	14.81	41.31	11996	39286	51282
Eunola			90	30	14.81	41.31	252	868	1120
Total/Average	1136	1334	90	30	15.95	41.22	18524	56289	74813
			Damage	Free	Conditions				
Yauhanna			120	45	51.32	53.12	3182	3825	7007
Meggett			100	45	24.62	53.12	4505	11368	15873
Witherbee			75	30	-7.38	36.62	-472	2783	2311
Eulonia			100	40	24.62	49.12	19942	46713	66655
Eunola			100	40	24.62	49.12	419	1032	1451
Total/Average	1136	1334	100	40	24.54	48.56	27576	65721	93297

d. Viability. The plan evaluated appears to be economically feasible with a benefit-to-cost ratio of 1.27. Implementation of the plan would result in increase in agricultural yields. Such a plan, however, would not fall under the authorities of the Corp of Engineers in as much as their prime objective "...will be to provide protection for downstream agricultural flood plains and for urbanized areas where flood problems of major magnitude exist..."1/

DISCUSSION

It appears that there are no problems in the Waccanaw River Basin which need or could be addressed with a basin wide solution. Problems which would be treatable under programs administered by the Corps of Engineers may be addressed under and within the funding limits of continuing authority programs. The only problems which appear to require Corps of Engineers attention at this time are the urban flooding problems near Conway, S. C.

Agricultural flooding and drainage problems are very local in nature and do not fall under the purview of Corps of Engineers authority. In downstream areas, the various agriculturally oriented tributary streams are swamps. Such wetlands are to be preserved rather than developed. Policy guidance concerning such matters is contained in Executive Orders 11988 and 11990. As was mentioned previously, agricultural flood control and drainage are very low on the national priority list.

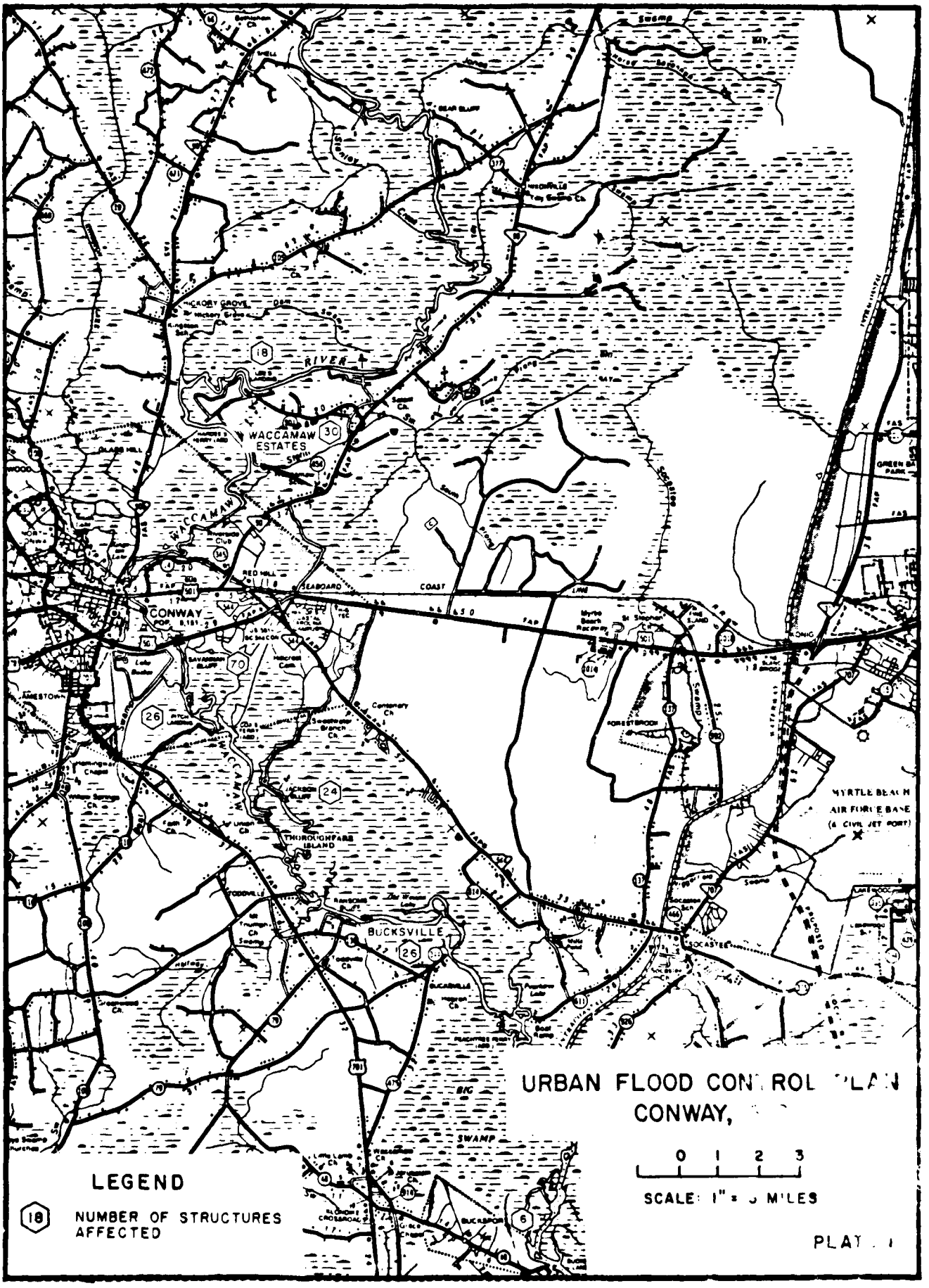
RECOMMENDATION

It is recommended that the general investigation authorized by the Committee on Public Works of the House of Representatives on 19 October 1967, be terminated on the basis of findings reported herein, and that the requirements of the resolution be considered satisfied.

B.E. Stalmann

Bernard E. Stalmann
LTC, Corps of Engineers
Commanding

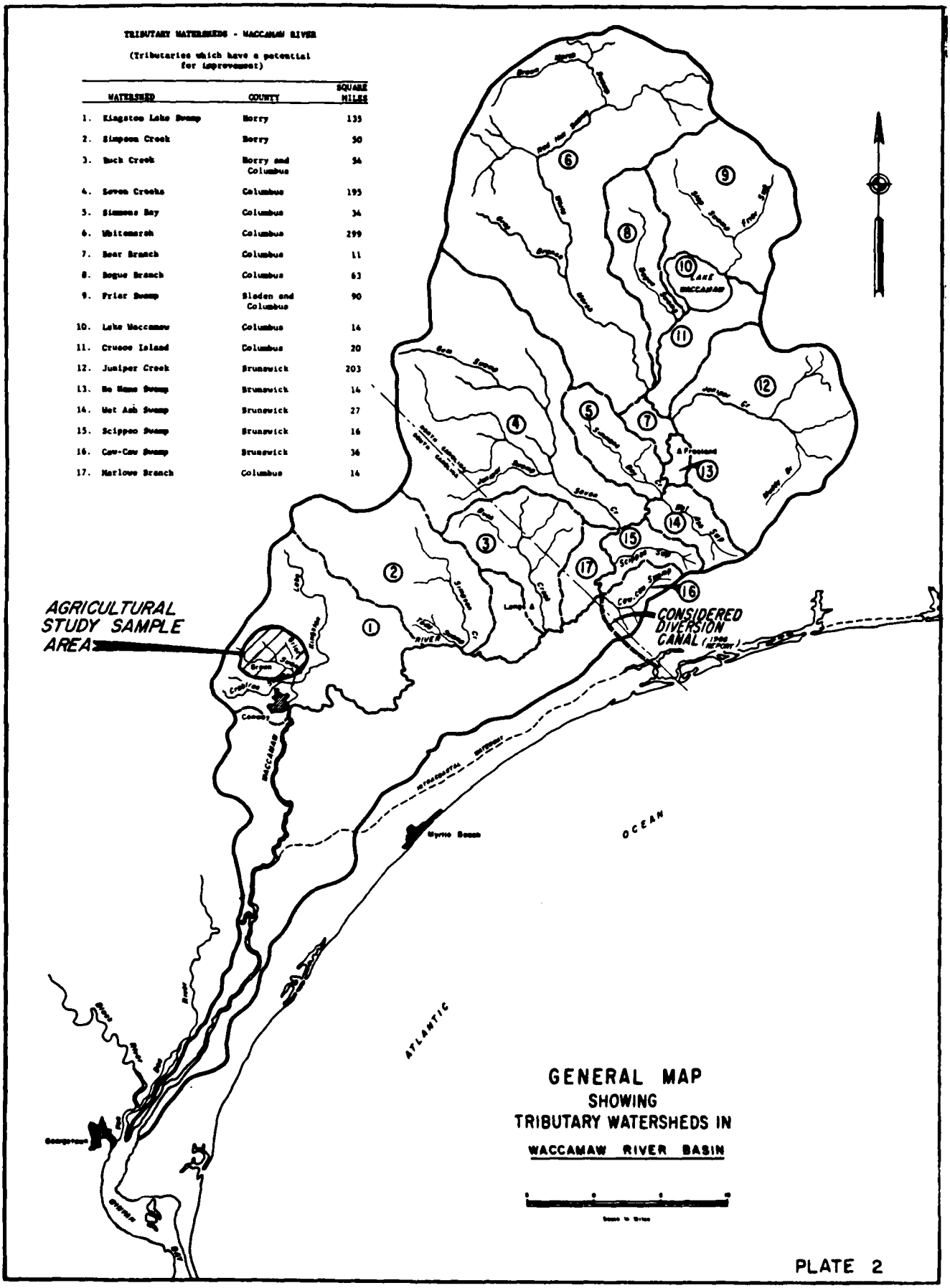
1/ Agreement between Soil Conservation Service and Corps of Engineers (23 September 1965)


WACCAMAW ESTATES
CONWAY
BUCKSVILLE
THOROUGHFARE ISLAND
MYRTLE BEACH AIR FORCE BASE
(& CIVIL JET PORT)
SEABOARD COAST LINE
SWAMP
LEGEND
18 NUMBER OF STRUCTURES AFFECTED
URBAN FLOOD CONTROL PLAN
CONWAY,
0 1 2 3
SCALE: 1" = 3 MILES
PLATE 1

TRIBUTARY WATERSHEDS - WACCAMAW RIVER

(Tributaries which have a potential for improvement)

	WATERSHED	COUNTY	SQUARE MILES
1.	Kingston Lake Swamp	Horry	135
2.	Simpson Creek	Horry	50
3.	Buck Creek	Horry and Columbus	54
4.	Seven Creeks	Columbus	195
5.	Simmons Bay	Columbus	34
6.	Whitemarsh	Columbus	299
7.	Bear Branch	Columbus	11
8.	Bogue Branch	Columbus	63
9.	Prior Swamp	Bladen and Columbus	90
10.	Lake Waccamaw	Columbus	14
11.	Crusoe Island	Columbus	20
12.	Juniper Creek	Brunswick	203
13.	No Name Swamp	Brunswick	14
14.	Wet Ash Swamp	Brunswick	27
15.	Scippeo Swamp	Brunswick	16
16.	Cow-Cow Swamp	Brunswick	34
17.	Marlowe Branch	Columbus	14



GENERAL MAP
SHOWING
TRIBUTARY WATERSHEDS IN
WACCAMAW RIVER BASIN

PLATE 2

APPENDIX 1

Waccamaw River Basin Reconnaissance Report

SUMMARY OF INITIAL PUBLIC MEETING ON WACCAMAW RIVER

SURVEY INVESTIGATION

A. Basic Information

One initial public meeting was held on:

Date: 20 November 1979

Place: Horry County Court House, Conway, S. C.

Attendees: 60 persons

B. Objective of Meeting

1. Inform the public about the Corps' planning process, with emphasis on the conduct of survey investigations.

2. Explain the nature and scope of the study and initiate public participation as an integral part of the process.

3. Request from the public their opinions and perceptions of objectives, needs, and preferences regarding flood control problems and other water-related problems in the study area.

C. Conduct of the Meeting

The meeting was conducted by Colonel William W. Brown, District Engineer, Charleston District, and Edwin W. Meredith, Chief, Planning and Reports Branch. Col. Brown initiated the meeting and directed the statement period. Mr. Meredith responded to administrative and technical questions.

D. Salient Points. The meeting was well publicized. The mailing list included: U.S. Senators and Congressmen, state legislators, governors and mayors of the basin area, federal, state and local agency officials, private individuals, and organizations, as well as postmasters, and the public media-radio, television and newspapers. This exposure resulted in a well-represented attendance of 60 persons. Many had prepared statements, and the meeting was a relatively long one, as the public was anxious to express their views, particularly with respect to the flooding problems at Conway, S. C. Inputs from the meeting can be summarized as follows:

1. Flood control. Individual citizens and local officials stressed the fact that flooding caused by heavy rains in the past have resulted in large losses of property and much suffering and hardship. The uncertainty and potential danger of the floods poses a heavy burden on the individuals in low-lying areas.

Many attendees felt the considered diversion at the state line would alleviate the flooding problem at Conway, while others proposed a combination of the diversion and river improvements. Persons concerned with flooding at Whiteville, N. C. felt clearing and snagging of Soules Swamp would solve flooding problems and provide new land for development. All persons at the meeting were extremely concerned with any modifications what would affect the river's natural beauty and environmental quality.

2. Land use. Less than 5% of the Waccamaw Basin is utilized for residential and commercial purposes. However, the most desirable high land along the river has generally been developed, and most flooding of residential improvements are located along the main stem. Flood plain regulations are viewed as deterrent to further development. Many voiced the desire that any structural modifications of the river should be prohibited. Others stated immediate need for flood stage reduction along the main stem by any means available. Many in attendance also experssed a desire for tributary improvements which would improve agricultural lands and hdlp alleviate flooding of residential and commercial property and roads that are frequently inundated.

3. Other concerns. Although private, special interest, and government representatives spoke primarily on flooding and drainage problems and the necessity to maintain and improve the environmental quality of the basin, some other frequent concerns mentioned were:

a. Control of mosquito breeding areas

b. Development of surface water supplies in the Grand Strand area

c. Control of flood plain development

d. Hunting and fishing degradation from swamp drainage and tributary improvements

e. Low water in river during dry periods; a series of rubble wiers were suggested to maintain water levels that would support small recreational fishing boats

APPENDIX 2

FISH AND WILDLIFE RESOURCES OF THE WACCAMAW RIVER BASIN, NORTH AND SOUTH CAROLINA

USFWS Stage 1 Planning-aid Report

Waccamaw River Basin Study

July 1981

Prepared by

Catherine C. Dunn, Fishery Biologist
Division of Ecological Services
Charleston, South Carolina

FISH AND WILDLIFE RESOURCES OF THE WACCAMAW RIVER BASIN, NORTH AND SOUTH CAROLINA

USFWS Stage 1 Planning-aid Report

Waccamaw River Basin Study

July 1981

Prepared by

Catherine C. Dunn, Fishery Biologist
Division of Ecological Services
Charleston, South Carolina

Table of Contents

LIST OF FIGURES

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 12559
217 FORT JOHNSON ROAD
CHARLESTON, SOUTH CAROLINA 29412

July 22, 1981

Lt. Colonel Bernard E. Stalmann
District Engineer
U.S. Army Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Colonel Stalmann:

Attached is our Stage 1 Planning-aid Report for the Waccamaw River Basin Study currently being conducted by the Charleston District. This report is provided on a planning-aid basis and does not fulfill our total responsibilities under the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Despite the short time frame in which we had to prepare this report and the limited funding provided, the Service was able to provide considerable reconnaissance - level information on the Basin's fish and wildlife resources due to recent work in the adjacent Lumber River Basin and to our staff biologist's familiarity with the Waccamaw River. Future FWCA activities and requested funds represent our best estimate regarding FWS involvement needed to accurately and adequately assess potential impacts of water resources development, in particular flood damage protection and agricultural drainage, in this ecologically significant basin. We appreciate the opportunity to provide these comments and look forward to working with the Charleston District on this study.

Sincerely yours,

Catherine C. Dunn

Catherine C. Dunn
Acting Field Supervisor

CCD/lm
Attachment

GENERAL DESCRIPTION OF STUDY AREA

The Waccamaw River Basin lies within the Coastal Plain Physiographic Province in southeastern North Carolina and northeastern South Carolina (Figure 1). The Basin, which is 160 miles long and drains approximately 1,500 square miles (around 500 square miles in South Carolina and 1,000 in North Carolina), includes portions of Bladen, Columbus, and Brunswick counties in North Carolina and Horry and Georgetown counties in South Carolina. The Waccamaw River originates at Lake Waccamaw in Columbus County, North Carolina and flows south approximately 56 miles to the North Carolina-South Carolina state line. From there it flows in a southwesterly direction and then southerly for about 90 miles to empty into Winyah Bay at Georgetown, South Carolina.

The Waccamaw River is a blackwater river typical of the southeastern coastal plain. It is 4,000 feet wide at its mouth; 192 feet wide at Conway, South Carolina (42 miles upstream), and varies from 35 to 180 feet wide from Conway to Lake Waccamaw. Tides influence the river as far as 82 miles upstream; tidal range at the mouth is 3.2 feet and at Conway is 1.2 feet. The floodplain is broad and in the lower 20 miles the river is connected by tidal creeks to the Pee Dee River. Sloughs, oxbows, alluvial terraces, and deltaic facies mark the floodplain, recording the river's history of repeated embayment and a meandering river channel. Geologically, this river is young, but it has cut through the easily erodible coastal sands to expose facies of five coastal terrace formations and occasionally the underlying limestones. Several geologically important fossil sites have been found upstream from Conway (Coastal Zone Resources Corporation 1973).

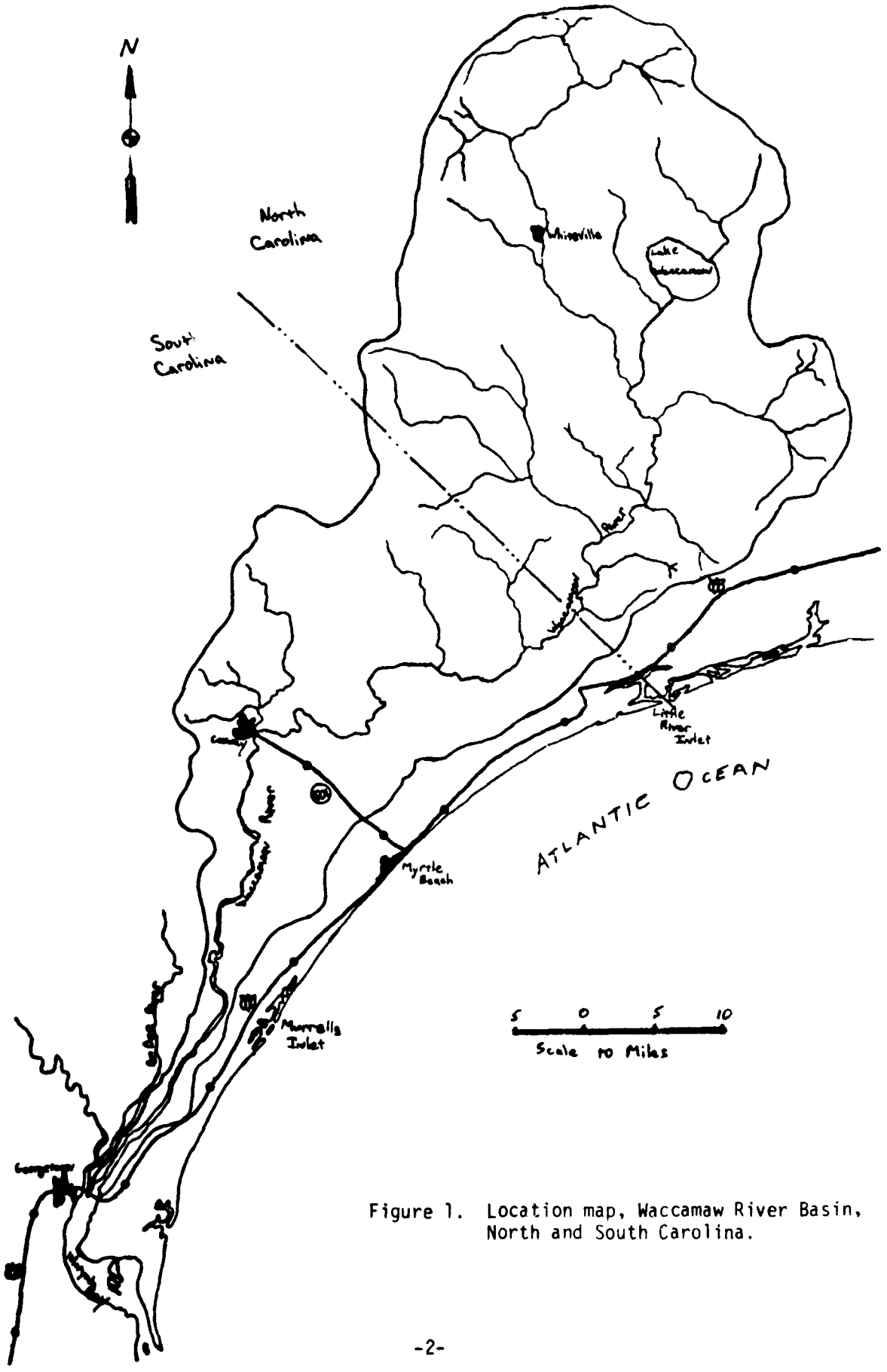


Figure 1. Location map, Waccamaw River Basin, North and South Carolina.

Much of the Waccamaw River Basin is vegetated by seasonally flooded bottomland hardwoods, wooded swamps, pocosins, Carolina bays, and bogs, wetland communities that develop on alluvial plains and in poorly drained areas. Within the Basin are some of the best remaining examples in the Carolinas of plant communities such as pine savannahs, bay forests, and extensive pocosins. Rare and threatened and endangered plants and animals are found throughout the Basin, and significant archeological sites are known to occur within the study area. Indicative of the Basin's resource significance was the designation in 1974 of a portion of the Green Swamp, located in Brunswick County on the drainage divide between the Waccamaw and Cape Fear rivers, as a National Natural Landmark. Although much of the Basin has been heavily timbered, extensive riparian development typical of many of the Carolinas' coastal rivers has not occurred along the Waccamaw and the river is on the Heritage Conservation and Recreation Service's 1980 Rivers Inventory (U.S. Department of Interior 1980) that lists rivers with potential for further consideration for the National Wild and Scenic Rivers System. Preliminary analysis by the North Carolina Department of Natural Resources revealed the Waccamaw meets all criteria for inclusion in the State's Natural and Scenic Rivers Program. The unique vegetative diversity, prime natural communities, and rare and endangered species combine to make this Basin one of the states' most significant in terms of fish and wildlife resources.

DESCRIPTION OF MAJOR HABITATS

Major habitats within the Waccamaw Basin fall into three general land use categories: 1) agricultural lands, 2) upland forest lands, and

3) wetlands, including open water. Urban and built-up lands in the Basin do provide some wildlife habitat, particularly for birds and small mammals, but due to their limited areal extent they are not considered a major habitat.

A. Agricultural Lands

Agricultural lands, which include cropland, pastureland, and orchards, are prevalent throughout the Basin. These lands are often located in cleared floodplain areas where a cover of alluvium provides deep fertile soil.

Vegetation development in croplands and pastures depends upon two seed sources -- buried viable seeds (Oosting and Humphries 1940) and dispersal from nearby communities. The combination of these two sources produces a highly diverse assemblage, provided that disturbance from cultivation and seasonal plowing occur. Once the croplands are abandoned, the diversity of annual weeds is replaced by a constituency of perennial weeds and later by seedlings of tree and shrub species. A colonizing sequence has long been noticed in plant composition, and the chronological timing has been investigated at numerous sites where the abandoned cropland situation exists. These investigations lend considerable strength to the concept of succession that originated with Warming in Denmark (1891, as cited in Morrison and Yarranton 1974) and that was popularized by Cowles (1899) in his classic study of the Indiana sand dunes. The work of Oosting (1942), Keever (1950), Quarterman (1957), and Odum (1960) in the southeastern United States established "old-field succession" as the model for "ecosystem development" by which croplands

and pastures, barring continued disturbance by man, revert to forests. Thus the biotic composition of croplands should in a broad sense be viewed as a community in transition, with the degree of old field or forest expression directly related to the extensiveness and frequency of disturbance. Considered in this respect, the occasional trees or shrubs in pastures or perennial grasses in old fields can be understood more clearly.

Characteristic vegetation of fields and pastures includes many species of annuals and perennial asters, grasses, and legumes. In fallow fields, weeds such as Queen Anne's lace (Daucus carota), horseweed (Erigeron canadensis), plantain (Plantago lanceolata, P. virginica, P. aristata), horse nettle (Solanum carolinense), dog fennel (Eupatorium capillifolium), and goosegrass (Eleusine indica) may occur with or may replace crabgrass (Digitaria sanguinalis), Johnson grass (Sorghum halapense), and morning-glories (Ipomoea spp.). In older fields that have lain fallow for a few years, there may be other seral stages of old field succession such as broomsedge (Andropogon virginicus), horseweed, and pine seedlings. In still older fields the invasion of pine and hardwood seedlings may make aerial distinction between agricultural lands and forested lands impossible since the fields are truly in a transition period from one type of land use to another.

The plants of pastures often include occasional trees, usually young pines, which are left to give shade to livestock. Fescue (Festuca octoflora, F. elatior, and F. obtusa), clover (Trifolium spp.), and other varieties of grasses are sown for pasture, and sometimes small grain fields of mixed wheat, oats, rye, or barley are temporarily fenced

for livestock grazing. After harvest, corn fields are often fenced for swine prior to the fall or winter slaughter. Not infrequently, adventive weeds are introduced into pasture lands through livestock feed, contamination of seeds purchased for sowing, animal vectors, or wind or other abiotic means.

Croplands and pastures play an integral role in the Basin, especially when they are located within proximity to woodlands or bottomlands. Individuals of many species of birds and mammals often travel several miles and pass through many community types, including croplands, in one day's or one night's hunt. Wintering flocks of waterfowl move more or less regularly from lake to lake or farm pond to farm pond. Crows, robins, mourning doves, blackbirds, and starlings accumulate in late summer-early fall, and winter roosts that may number 50,000 or more fly out as many as 50 to 70 miles each morning to feed in fields, pastures, feedlots, woods, and various ecotones, then return each night to their established roosting site in thicket woodlands. In so doing, these birds often "stage" or tarry around such open areas as landfills, hedgerows, fields, and meadows.

Diverse habitats, large open spaces, and unimpaired mobility are necessary to the survival of large birds of prey. Hawks, vultures, and owls nest or roost in various types of woodland habitats but forage across fields and pastures. Wintering flocks of goldfinches, evening grosbeaks, and purple finches do not have the local home ranges typical of most small birds but rather roam loosely across several woody communities and old field ecotones. In spring and fall migration, large numbers of species "spill out" of their usual preferred habitats and

forage wherever proves to be advantageous. Many of the larger mammals (opossum, raccoon, striped skunk, red fox, gray fox, otter, deer) and the bats also range across considerable distances and several community types in a single foraging expedition. Their appearance in croplands and pastures, or overhead these areas in the case of bats, can sometimes be observed during twilight or dawn hours. Croplands and pastures contain the preferred foods of herbivores, which in turn are preyed upon by carnivorous species. As with the birds, each of these mammals has a primary or preferred habitat for breeding and for nesting or resting cover, but they do exploit additional communities found within their ranges.

Croplands and pastures make up the majority of agricultural lands in the Basin, but orchards, horticultural areas, dairy operations, beef cattle farms, and poultry farms also fall in this category. These areas are relatively small and provide little wildlife habitat. Also included in agricultural lands are ditches and canals, small farm ponds, hedgerows, and narrow strips of thicket. The differences between cropland and pastures and these areas are in many cases extremely subtle and the biotic composition may be only slightly or not at all different. The small scale of the differences is advantageous only to those plants and animals that thrive on small space or in frequently disturbed areas. The eastern mole and American toad seem to frequent these kinds of habitats. Small farm ponds often have a periphery of aquatic or marsh plants which provide food and cover for wetland species; muskrats and ducks frequent these ponds. Hedgerows and narrow thicket strips provide important habitat where small game animals like the eastern cottontail,

bobwhite, mourning dove, and numerous species of rodents and songbirds find food, cover, and nesting sites when fields are plowed, harvested, or otherwise disturbed. Birds of prey such as hawks may perch along hedgerows during the day, while owls use hedgerow trees for observation during the night. The plant life which provides all of these amenities for wildlife are such species as blackberry (Rubus argutus), Japanese honeysuckle (Lonicera japonica), sassafras (Sassafras albidum), black cherry (Prunus serotina), red cedar (Juniperus virginiana), and others. Around old house sites may be remnants of formerly cultivated species of plants such as chinaberry (Melia azederach), hog plum (Prunus umbellata), tree-of-heaven (Ailanthus altissima), or fruit trees such as peach and pear.

B. Upland Forest Lands

Upland forest lands may be divided into three categories: 1) deciduous, all forest areas having a predominance of trees that lose their leaves at the end of the frost-free season or at the beginning of a dry season; 2) evergreen, all forested areas in which the trees are predominantly those which remain green throughout the year including both coniferous and broad-leaved evergreens, and 3) mixed forest lands, all forested areas where both deciduous and evergreen trees are growing and neither predominates.

Slope, exposure, moisture, soil depth, and nutrient availability all affect the distribution of plant species within each of these major forest types and numerous vegetative associations (oak-hickory, longleaf

pine-scrub oak, etc.) exist. To some extent, wildlife use of the major forest categories within a given area varies depending upon the vegetative associations present. With many wildlife species, however, the difference is in the degree of use of various associations and not the use or lack of use of any given association. Thus, identification of major forest types does provide general information with which to evaluate likely wildlife use of and potential habitat value of any given study area. However, detailed analysis of vegetative associations is necessary to adequately evaluate an area's wildlife values; such analysis will be conducted during Stage 2 studies.

1. Deciduous forest lands.

Deciduous forest lands constitute the smallest acreage of upland forests within the Basin. Mixed hardwood associations do occur, however, generally on flat ridges and on lower slopes that grade onto alluvium. These communities frequently have been selectively harvested and there is much variation in canopy species. Typical canopy species are red maple (Acer rubrum), red oak (Quercus rubra), tulip poplar (Liriodendron tulipifera), mockernut hickory (Carya tomentosa), black oak (Quercus velutina), beech (Fagus grandifolia), and sweetgum (Liquidambar styraciflua), with a subcanopy that includes pawpaw (Asimina tribola), ironwood (Carpinus caroliniana), redbud (Cercis canadensis), and flowering dogwood (Cornus florida). One such association known to occur in the Coastal Plain and likely within the Basin is the southern sugar maple-mixed hardwood association in which southern sugar maple (Acer saccharum ssp. floridanum) is the dominant canopy species, with red ash (Fraxinus

pennsylvanicum), mockernut hickory, swamp red oak (Quercus shumardii), and beech also present.

Deciduous forest wildlife may be separated into vertical zones of habitation; these are zones that are provided by the ground, understory, and overstory layers. Bird species that feed and/or nest in the ground layer are the ovenbird, veery, brown thrasher, fox sparrow, and woodcock. Woodland game animals, including raccoon, opossum, whitetailed deer, gray squirrel, eastern cottontail, mourning dove, and bobwhite, also use habitat found in the ground layer. The short-tailed shrew represents the small, less mobile mammals typical of this layer. Reptiles in the deciduous forest are abundant and diverse. Common inhabitants include the eastern box turtle, eastern hognose snake, and broad-headed skink. Terrestrial woodland salamanders that use humid microhabitats throughout the ground layer are the spotted salamander, marbled salamander, and eastern tiger salamander.

Abundant food and protective cover is found in the understory layer. Birds such as the wood thrush, hooded warbler, and downy woodpecker inhabit this layer. Gray squirrels, opossums, and southern flying squirrels nest in snags, hollow trees, and understory trees.

The forest canopy supplies seasonal blossoms, buds, and seeds as well as emergent insects that are used for food by the red-eyed vireo, scarlet tanager, tufted titmouse, common flicker, and various warblers. The abundant birds and small mammals are preyed upon by two typical residents of the deciduous forest, the great-horned owl and red-tailed hawk. Feeding throughout the forest and roosting in its hollow trees and dense foliage are several bat species that include the little brown

myotis, eastern pipistrelle, and red bat. Although frogs are usually associated with water, the gray treefrog typically forages and calls high in the deciduous canopy.

Transition zones between the deciduous forest and mixed or evergreen forests and old fields provide habitat diversity suitable for avian species not characteristic of either community. The common crow is a ubiquitous visitor of such ecotones, although for roosting and nesting this bird seems to prefer dense pine woodlands. Birds common to this edge habitat are the song sparrow, indigo bunting, common yellowthroat, and prairie warbler. The Cooper's hawk and sharp-shinned hawk frequently perch and hunt along the forest-field ecotone.

2. Evergreen forest lands.

Evergreen forests in the Basin consist primarily of shortleaf pine, longleaf pine, and loblolly pine associations and of loblolly and slash pine plantations. Pine forests usually occur on soils of low fertility and high acidity, commonly on old fields long abandoned or on sites formerly covered by forests in which the canopy species have been timbered and/or burned. In these pine forests, canopy closure results in decreased light levels. Pine seedlings are not as successful as hardwood seedlings under these conditions and, when the shade tolerant seedlings and saplings of hardwood species survive, young pine saplings often die before reaching full sunlight. The understory, therefore, is usually dominated by hardwood species. Under normal succession, the evergreen forests gradually revert to mixed forests and eventually to deciduous forests, according to the classic papers on old field succession.

The major evergreen forests in the Waccamaw Basin are dominated by loblolly pine (Pinus taeda) or longleaf pine (P. palustris). Loblolly pine communities consist of pure stands of loblolly pine or stands where this species is predominant. Southern red oak (Quercus falcata), white oak (Q. alba), post oak (Q. stellata), tulip poplar, sweetgum, longleaf pine, black gum (Nyssa sylvatica), American holly (Illex opaca), persimmon (Diospyros virginiana), and dogwood are common associates on better drained soils. On poorly drained soils, species commonly found within this community include water oak (Quercus nigra), willow oak (Q. phellos), red maple, sweetgum, pond pine (Pinus serotina), and sweetbay (Magnolia virginiana). This forest type occurs on broad, nearly level uplands, in poorly drained depressions, and in abandoned fields and cutover areas -- loblolly pine is a very aggressive species and takes over old fields and heavily cutover or severely burned areas.

The longleaf pine community also occurs in the Basin. Common species found along with longleaf pine include sweetgum, tulip poplar, southern red oak, and white oak when the forest occurs on poorly drained soils. On well drained or excessively drained sands or loamy sands, common species dominating the understory include turkey oak (Quercus laevis), black jack oak (Q. marilandica), and scrubby post oak (Q. margaretta). After cutting or repeated burning, this community is generally succeeded by mixed stands of longleaf pine, oak, and hickory, and eventually by a hardwoods community.

Upland pine forests have less bird life in summer, both in species and in numbers, than either deciduous forests or wetland forests. However, the reverse is true in winter -- while the hardwood communities

are bare and open, there is a good supply of food and cover amidst the needles of the pines. In summer, the pines are hot, dry, and sunlit, while deciduous woods are shaded, cool, and moist. The yellow-throated warbler and the pine warbler are especially distinctive inhabitants of pines. The ruby-crowned kinglet also frequents pine stands.

In winter, pine and mixed pine-hardwood stands characteristically have mixed flocks of birds of up to 15 or more species and 100 or more individuals which slowly forage through the tree canopies. Common members of these groups are permanent and/or winter residents such as woodpeckers, nuthatches, tufted titmice, Carolina chickadees, Carolina wrens, and pine warblers.

In pine plantations where a depauperate hardwood understory occurs, the fauna is usually less diverse than in stands which contain patches of hardwoods, thickets, or a relatively diverse understory, as animal diversity is positively correlated with floral diversity. Although amphibians and reptiles are not as abundant in this community as in other types of communities, such as wetland forests, the American toad, eastern box turtle, eastern fence lizard, eastern hognose snake, northern black racer, and copperhead are frequent inhabitants. Mammals such as the gray squirrel and pine vole also utilize habitat in this community.

3. Mixed forest lands.

Mixed forest lands are those forested areas in which both evergreen and deciduous trees are present but neither predominates. Although acreage figures are not available, it is probable that this forest type is the most common in the Basin. Seldom does one encounter an upland forest stand which does not contain at least loblolly pine or red cedar

Much of what has been said of upland deciduous forest and evergreen forest is applicable to this land use designation. While the mixed forest land may be considered intermediate between hardwood and pine lands since the total plant composition contains features of both types, the overall relative importance of each species may be quite different. Occurrence of this forest type can be interpreted as 1) a post-mature pine forest in which pine is becoming less common, 2) a lumbered forest in which the hardwood species have been removed, or 3) a sustained mixed forest in which both hardwoods and pine are intermittently removed. Such hardwood species as sweetgum, black gum, tulip poplar, white oak, and the more xerophytic species of oak and hickory share the canopy dominance with pine. Understory species are the same as those mentioned for upland deciduous forests.

In the Waccamaw Basin, mixed forest associations include the loblolly pine-mixed hardwoods and the longleaf pine-scrub oak communities. In the loblolly pine-mixed hardwoods community located on wetter sites, loblolly pine is associated with various wet-site hardwoods, including sweetgum, red maple, laurel oak (Quercus laurifolia), willow oak, water oak, and black gum, as well as longleaf pine and pond pine. On drier sites, the hardwood component is composed of southern red oak, white oak, post oak, and hickory; longleaf pine is also often present. This community represents a transition between the evergreen loblolly pine forest and the deciduous mixed hardwood forest. The longleaf pine-scrub oak forest consists primarily of longleaf pine and trees such as turkey oak, black jack oak, and scrubby post oak. This forest type usually succeeds longleaf pine after cutting and/or repeated burning.

One of the ecological features of the upland mixed pine-hardwood forest in comparison with the mature hardwood forest is that the former is successionally transitional. The pine trees are in various stages of senescence, and as they die and decay the subsequent detritus (litter) is recycled in the forest ecosystem. This process is evident by the gradual establishment of new saprophytic organisms (decomposers) that produce changes in the physiochemical nature of the litter and upper soil horizons. These changes contribute to and are reflected by the appearance and development of upland hardwood forest species.

The mixed pine-hardwood community has a more varied terrestrial vertebrate composition than either the upland hardwood or the upland pine forests, because of the greater diversity of plant species and the tendency toward a greater and distinctive stratification. While the mixed forest is a definite vegetation type, both in biotic components and percentage presence in the area, its animal life is perhaps best understood as a combination of the pine and hardwood types. For instance, some nesting birds extending into the mixed woodlands from the pines are pine warbler, ovenbird, and brown-headed nuthatch, while some species from the hardwoods are the red-bellied woodpecker, downy woodpecker, and great crested flycatcher. The same mixing of species is true for winter-resident birds and a number of mammals, lizards, snakes, and amphibians.

C. Wetlands

Wetland communities in the Basin provide valuable, irreplaceable habitat for a wide variety of fish and wildlife species. These areas generally represent transitions from upland habitat to open water and

are characterized by complex physical, chemical, and biological interactions. Biota inhabiting wetlands are dependent upon the physical and chemical processes that created and now maintain these areas (i.e., rich alluvial soils, readily available moisture, periodic inundations). Wetlands are among the most productive biological systems, with annual production rates equal to or exceeding those of the best energy-subsidized agricultural lands. Three basic habitat types found within the wetland ecosystem in the Basin are forested wetlands, nonforested wetlands, and open water.

1. Forested wetlands.

Forested wetlands are wetlands dominated by woody vegetation and include seasonally flooded bottomland hardwoods, shrub swamps, wooded swamps, and bogs. These communities develop on alluvial plains and in poorly drained depressions. Water regime (i.e., frequency, duration, and timing of inundation) is a primary factor influencing species composition of these communities. Three major forested wetlands communities that occur in the Basin are the mixed bottomland hardwood, bald cypress-water tupelo, and Carolina bay communities.

a. Mixed bottomland hardwoods. The mixed bottomland hardwoods community occurs throughout the Waccamaw floodplain. This community is dependent upon seasonal inundation; a significant portion is inundated annually, on the average, by backwater flooding from the rivers. Rainfall, averaging from 46 to 52 inches per year over the area, extends the duration of inundation or saturation beyond that resulting simply from backwater flooding. Although the minimum duration of inundation required

to maintain these bottomland hardwoods communities has not been determined, it is well established that seasonal inundation is necessary to the continued existence of this community type.

Major canopy species of this community include sweetgum, red maple, laurel oak, swamp tupelo (Nyssa sylvatica var. biflora), overcup oak (Quercus lyrata), water oak, and widely scattered bald cypress (Taxodium distichum). Major subcanopy species include American holly, ironwood, and water ash (Fraxinus caroliniana).

The bottomland hardwoods community is essential to the survival and propogation of many fish species that occur within the Basin. These areas provide spawning and nursery habitat for a variety of fishes, many of which have become adapted to make the most efficient use of this alternately wet and dry community. In addition to providing spawning habitat, bottomland hardwoods also provide food sources that are essential to the survival of larval fish. Within a few days after hatching, the larvae must encounter an external food source or suffer death through starvation. (This transition to external feeding has been termed the "critical period" in the early stages of fish development, and several investigators have documented massive mortality in larval populations during this period.) Bottomland hardwood wetlands provide this essential external food source in the form of detritus, plant material broken into fragments by bacteria and fungi. The protein content of the plant material actually increases during this "breaking down" process, and larval fishes are able to feed directly on detritus until they become proficient at capturing prey. Bottomland hardwood wetlands further contribute to food availability through the process of "breaking" the

...er current. Calmer water allows natural aggregation of zooplankton communities, thus increasing the opportunity for larvae to encounter food. Plant leaves themselves serve as a substrate for algae, an additional type of primary producer and food source for some species.

Available spawning and nursery habitat provided by the bottomland hardwoods community is directly related to the areal extent of seasonal and yearly flooding. An increase in the area inundated allows an increase in spawning sites, plankton communities, and survival of young fish in like proportion. Studies have shown that during low water years when access to bottomland hardwood wetlands was limited the year class strength of the fish populations was inferior to normal flood years. Conversely, highly successful year classes have been noted from increased flood years.

The bottomland hardwoods community not only provides food for larval fish but also for many adult fish. It has been shown that detritus in or exported from bottomland hardwoods can constitute a major portion of the diet of some fish. Berrie's investigations (1976) in the River Thames revealed that more than half the volume of stomach contents in two species of sport fish, and greater than one-third the volume in another, consisted of detritus. Detritivores, including immature stages of aquatic insects, small arthropods, and annelid worms, which thrive in this wetland community are consumed in large numbers by juvenile and adult fish that are in turn eaten by larger fish. Lagler (1956) and Pennak (1953) both discuss the importance of aquatic insects to fish production; the importance of detritus as a food source for these insects and other invertebrates in a riverine wetland was documented by Scorgie

(1974), whose research in the River Lambourn revealed that 22 of 43 taxa of invertebrates studied were detritivores. Sniffen (1978) conducted a 2-year study of the effect of different periods of inundation on community composition and biomass accumulation of macroinvertebrate detritivores in a coastal North Carolina swamp. He found that 1) high standing crops existed in late February when many fish were spawning, and 2) the total macroinvertebrate secondary production of the swamp stream ecosystem increased by at least an order of magnitude because of the additional aquatic area created during seasonal floodplain inundation. Aquatic invertebrates are an essential food source for many fish in the Basin's rivers and an essential link in the food web of other species. The importance of the bottomland hardwoods community to many of these invertebrates has been clearly demonstrated; the importance of bottomland hardwoods to the Basin's fishery cannot be overstated.

Additionally, bottomland hardwoods provide backwater areas of reduced current velocity essential to many fishes. In a study designed to determine the swimming ability of several riverine species, Tunink (1977) found that even the maximum critical velocity attained by each species studied was insufficient to allow the fish to maintain themselves for any length of time in the main channel. He concluded that it is essential that areas of reduced current velocities be retained to provide suitable fish habitat. Although extensive data is not available on the swimming ability of species in the Waccamaw Basin, it is not likely that many (if any) of these species can maintain themselves in main channel currents for any length of time.

One other important aspect of bottomland hardwoods in relation to fish populations is the role this community plays in water quality. To survive and propogate, fish must have water relatively free of sediment and other pollutants. Bottomland hardwoods vegetation acts as a filter, removing much of the sediment from runoff before it reaches permanent lakes and streams. Also, the inorganic nutrients contained in main channel water are exchanged for organic material (leaf debris) located in the hardwood wetlands. This exchange benefits both systems by providing organic material for the permanent aquatic systems and inorganic material to be processed by the bottomland hardwoods community. The processes of water purification and nutrient exchange are vital to both the river and its associated wetlands.

The bottomland hardwoods of the Basin are essential to maintenance of the existing fishery. This community provides spawning, nursery, and feeding habitat, all vital to the continued existence of the Basin's fish populations. Bottomland hardwoods also provide habitat for waterfowl, marsh mammals (such as beaver, mink, and otter), and terrestrial species (including rabbit, fox, and raccoon). In late winter, the trees and open water provide shelter and feeding and resting areas for several species of waterfowl as well as nesting sites for wood ducks. The oaks found in this community produce acorn mast upon which ducks and some mammals feed. Insects and aquatic invertebrates found in abundance in bottomland hardwoods provide protein essential to waterfowl for successful reproduction. Ducks, unsuccessful at feeding in deep water, have adapted to take advantage of the vegetation and the concentrated invertebrate populations occurring in shallow water in the bottomland hardwoods

community. Wading birds, raptors and other avian species, small mammals, and large mammals use these bottomland hardwood areas on a regular basis, as they feed on the vegetation, abundant insects and other invertebrates, larval and adult fish, and each other.

b. Bald cypress-water tupelo. This community is found in poorly drained flat-bottomed valleys and sloughs in the lower portion of the Basin as well as in the vicinity of Lake Waccamaw. Dense stands of bald cypress and water tupelo dominate the canopy, while red maple and water ash dominate the subcanopy. This community, on the average, experiences a greater period of inundation/saturation throughout the year than the mixed bottomland hardwoods association. Bald cypress and water tupelo are extremely tolerant to extended periods of flooding and thus dominate this community, while less tolerant species such as those found in the mixed bottomland hardwoods community are eliminated or appear infrequently. Although tolerant of extended flooding, bald cypress and water tupelo require a dry period for seed germination; if totally submerged after germination, seedlings will die. Thus, either permanent flooding or elimination of seasonal flooding would result in the eventual destruction of this community type.

Further evidence of the influence of seasonal flooding on this community is found in studies of the growth of both bald cypress and water tupelo. It has been shown that not only the frequency and duration of inundation, but the timing of inundation during the growing season affect the basal area of cypress trees. Hook et al. (1970) reported that permanent flooding of water tupelo results in reduced tree growth, as stagnant water conditions cause an increase in soil carbon dioxide and subsequent restriction of root growth.

The Basin's existing cypress-tupelo stands are found in areas where the water regime is optimum for the survival and propagation of these species. Alteration of the hydrologic patterns in these areas would result in changes to existing bald cypress-water tupelo communities.

This community, like the mixed bottomland hardwoods community, provides habitat utilized by a variety of fish and wildlife species. Species found in this community are generally the same as those described as occurring in the bottomland hardwoods community, but extent of use varies somewhat. In general, fishery use of this community is greater than that of the bottomland hardwoods community due to more extensive flooding. This extended hydroperiod, however, also affects wildlife use. Mammals and birds, such as the raccoon, otter, osprey, and blue heron, that feed on fish and aquatic invertebrates utilize the bald cypress-water tupelo community quite extensively. Terrestrial species such as the whitetail deer, swamp rabbit, and gray squirrel utilize this community primarily for purposes of seeking refuge from predators. Waterfowl use of the bald cypress-water tupelo community is similar to that described for mixed bottomland hardwoods; the shallow waters frequently inundating this community provide excellent feeding and resting habitat for some species.

It is important to remember that the bald cypress-tupelo community is a transition from the aquatic ecosystem to the terrestrial and that its boundaries are not precise as shown on any map. This community is usually bordered by fresh marsh and/or permanent open water on one side and grades gradually into mixed bottomland hardwoods or upland communities on the other side. Bald cypress-water tupelo wetlands are therefore

used by a wide variety of fish and wildlife species. These wetlands also provide detritus which serves as the base of many food webs. Additionally, the bald cypress-water tupelo community removes sediment and traps nutrients and pesticides, thus aiding fish production. Elimination of this community type would result in the loss of important fish spawning and nursery habitat and the elimination of both fish and wildlife feeding and resting areas. Detrital import to the aquatic ecosystem would be lost, nutrient removal from flood water would not occur, and runoff containing sediments, pesticides, and nutrients would reach stream waters unretarded and in large quantities in areas where the bald cypress-water tupelo community is removed. Thus, major alteration or destruction of this community would adversely affect both fish and wildlife in the Basin and severe population reductions, especially in fish populations, could result.

c. Carolina bays. Carolina bays, natural wetland communities, are defined as "elliptical or ovate shallow depressions with their long axis oriented in a northwest-southeast direction and usually having a sand ridge along their southeast side" (Porcher 1966). These bays, which occur exclusively in the Coastal Plain physiographic province, are scattered throughout the Waccamaw drainage.

Soil characteristics, in conjunction with hydroperiod, fire regime, and the presence and depth of peat, influence the vegetation of Carolina bays. Three vegetative community types have been identified as occurring in these bays. Although these community types occur in other physiographic situations, they occur most often in Carolina bays.

1) Evergreen Shrub or Pocosin. In this community the depression has become filled with peat bringing the soil surface nearly level with that of the surrounding uplands. If fire is excluded this community type succeeds into a bay forest. However, following a deep peat burn this community will succeed into a Pond Cypress-Swamp Tupelo Community (Wells 1946; Penfound 1952). Evergreen shrubs dominate and have been described as existing in two zones, the tall or high zone and the short or low zone. Species commonly found in the tall zone include pond cypress (Taxodium ascendens), sweet bay (Magnolia virginiana), red bay (Persea borbonia), and loblolly bay (Gordonia lasianthus). Swamp cyrilla (Cyrilla racemiflora), bamboo smilax (Smilax laurifolia), sweet galberry (Ilex coriacea) and wax myrtle (Myrica cerifera) are commonly found in the short zone (Porcher 1966; Radford 1976).

2) Pond Cypress-Swamp Tupelo Community. This community type is found in depressions having standing water part of the year and in which little or no peat is present. Pond cypress and swamp tupelo dominate the canopy, with sweet bay, red bay, and loblolly bay dominating the subcanopy. A shrub layer including such species as fetterbush (Lyonia lucida), honeycup (Zenobia pulverulenta), fetterbush (Leucothoe racemosa) and highbush blueberry (Vaccinium corymbosum) is also present (Porcher 1966).

3) Bay Forest Community. This community type has been described as a later stage of the Pond Cypress-Swamp Tupelo Community in which sweet bay, loblolly bay, swamp tupelo, pond pine, red maple and pond cypress dominate the canopy. An evergreen shrub layer is also present and commonly includes hollies (Ilex spp.), swamp cyrilla, sweet

pepperbush (Clethra alnifolia), fetterbushes (Lyonia spp.) honeycup, and wax myrtle (Radford 1976).

Due to the fertile soils and the timber resources often found in Carolina bays, many of the bays in the Basin have been logged and/or cleared and drained for cropland. Disturbance (i.e., draining, ditching, cutting) of these bays often results in the community reverting to an earlier successional stage or in destruction of the community altogether.

There is a paucity of data on fish and wildlife use of Carolina bays. Generally, fish use is limited, since this community usually does not provide permanent water and since most Carolina bays are located outside the floodplain and have no connection with the Basin's rivers and streams. Fish use of Carolina bays located within the floodplain, however, is likely to be similar to that of the mixed bottomland hardwoods community. Wildlife use of these areas is also expected to be similar to use of the Basin's bottomland hardwoods, although use by terrestrial species is likely to be more extensive.

In summary, the forested wetlands of the Basin are quite valuable communities. They provide valuable habitat for some of America's rarest animal species, natural storage for floodwaters, water treatment for purifying water, extremely high organic productivity (gross primary productivity of southern swamps has been estimated at 20,000 kilocalories per square meter per year (KCal/m^2/yr) on average favorable sites, and at 40,000 KCal/m^2/yr on especially favorable sites - personal communication, Eugene Odum, as cited in Wharton 1969), as well as an excellent scientific laboratory where one may study the fundamental ecological interrelationships between the physical and biotic components of the natural environment (Wharton 1969).

2. Nonforested wetlands.

Nonforested wetlands are dominated by herbaceous vegetation and, like forested wetlands, serve many functions. These areas provide valuable waterfowl habitat, stabilize shorelines and river banks against erosion, act as sediment traps and water purifiers, contribute to the nutrient input of adjacent streams and lakes, and produce organic matter for many herbivores and omnivores which in turn may be consumed by carnivores. This fragile community with its many available habitats is vital to the survival of many wildlife species, as well as to many fishes whose young utilize wetlands as nursery areas. The complex relationships among species dependent upon the wetland environment provide the balance and stability necessary for the survival of the community as a whole. Man's activities - home construction, stream channelization, water impounding, waste disposal, etc. - can quite easily upset this delicate balance and cause irreparable damage to and subsequent loss of these wetlands and their associated wildlife.

Nonforested wetlands occur throughout the Basin as overgrown ponds covered by freshwater marsh species or scattered wetland shrubs, freshwater marsh located along streambanks and lakeshores, and brackish water marsh along the lower reach near Winyah Bay. Small areas of fresh marsh, which occurs in waters with less than 0.5 parts per thousand salinity, may be found scattered throughout the Basin. Fringe areas along streams, lakes, and ponds are often vegetated with fresh marsh species or scattered wetland shrubs. The typical vegetation is crowded, of low height, perennial, and home for numerous animals of biological interest. Shrubs occur only occasionally in this community and are

usually represented by alder and buttonbush (Cephalanthus occidentalis); more common are herbaceous growths of lizard's tail (Saururus cernuus), arrow arum (Peltandra virginica), broadleaf cattail (Typha latifolia), woolgrass bulrush (Scirpus cyperinus), rush (Juncus effusus), and knotweed (Polygonum sagittatum).

The greatest areal extent of nonforested wetlands is along the river in the lower portion of the Basin. These fresh to brackish marshes are tidally influenced and in many cases have been severely altered -- most in the lower 20 miles of the river were impounded and used for rice production during the eighteenth and nineteenth centuries. While these marshes are no longer used for rice cultivation, the impacts of this earlier use are still evident today. Also, many of these areas were and are still managed for waterfowl, another use which alters the natural vegetation of this community.

In areas no longer managed for rice production or waterfowl use, conversion back to natural tidal freshwater marsh has occurred or is occurring. In these areas, giant cutgrass (Zizaniopsis miliacea) is the dominant species with broadleaf cattail, wild rice (Zizania aquatica), and pickerelweed (Pontederia cordata) as co-dominants. Other species present include duckpotato (Sagittaria latifolia), mock bishop's-weed (Ptilimnium capillaceum), arrow-arum, dotted smartweed (Polygonum punctatum), beak rush (Rhynchospora corniculata), water-parsnip (Sium suave), and beggar ticks (Bidens spp.). Pure stands of woolgrass bulrush and marsh hibiscus (Hibiscus palustris) are often present, along with scattered red maple, swamp tupelo, and bald cypress. Aquatics such as spatterdock (Nuphar luteum var. sagittifolium), alligatorweed (Alternanthera

philoxeroides), and various duckweeds (Lemna spp.) are found growing in the old canals and in the river along the edge of the marsh.

In areas being managed, the marshes are diked to form impoundments which provide food and habitat for waterfowl. Prescribed burnings and water level control are used to increase preferred duck food plants and to suppress vegetation of low value to waterfowl. Plant species being managed for in the area include swamp smartweed (Polygonum hydropiperoides), big leaf tearthumb (Polygonum arifolium), softstem bulrush (Scirpus validus), squarestem spikerush (Eleocharis quadrangulata), and marsh dayflower (Aneilema keisak) (Conrad 1965).

Nearly all of the natural values of the fresh marsh community can be traced to the nature and amount of its primary production (i.e., the conversion of inorganic nutrients and radient energy into organic material). Productivity values for typical freshwater marsh macrophytes, such as those listed above, fall in the range of 500 to 2000 gm/m/yr (Whigham and Simpson 1976; Whigham et al. 1978; Good, Whigham, and Simpson 1978). Probably the primary reason for this high productivity is the ready availability of water and nutrients essential for photosynthesis. These plants actively absorb nutrients from the substrate and/or the water column, temporarily storing them as organic matter -- this "nutrient pump" function prevents nutrients from being washed immediately from the system or lost permanently to the sediment. Upon the death and decay of these plants, the nutrients are converted to inorganic form and are gradually released and made available for reuse in the primary production process (Clar[illegible] ,974).

However, it is not only the quantity of primary production of the fresh marsh community that is important, but also the quality of that production. Major primary producers in the salt marsh community are grasses that have little immediate nutritional value to fish and wildlife (Teal 1962). In contrast, the fleshy broad-leaf plants characteristic of fresh marshes generally are high in nitrogen and low in fiber content and there is a high incidence of direct grazing or feeding on these plants. In addition, fresh marsh vegetation is a significant source of detritus.

The value of the high primary productivity of freshwater marshes becomes apparent only when one realizes that the productivity or livelihood of the entire wetland community, and often of surrounding regions, is totally dependent on the organic matter produced by the macrophytes, plankton, and algae of the wetlands. All the organisms living in the marsh area depend directly or indirectly on these plants for food, and most of these creatures also require the cover and protection offered by the vegetation. Indeed, this "edge" between water and land serves as the principal habitat for many of the life stages of the fish, wildlife, and waterfowl associated with the Basin's wetlands.

Fresh marsh vegetation provides detritus to the aquatic ecosystem and serves as the base of the food web that supports the Basin's freshwater fishery. The leaves of the larger macrophytes in this community are used as attachment places by mollusks, insect nymphs, rotifers, hydra, and midge larvae, all important fish food. The submerged littoral zone is vital to the development of the Basin's freshwater fish, as these areas are the principal spawning sites and juvenile habitat for many

species. Principle game fish that utilize habitat in the Basin's fresh marsh community include bluegill, redbreast sunfish, and black crappie. Other species that utilize the freshwater marshes include American shad, blueback herring, carp, pickerel, and gar. During summer months significant concentrations of the endangered shortnose sturgeon, Acipenser brevirostrum, have been observed in waters adjacent to fresh marsh on the Waccamaw (personal communication, S.C. Wildlife and Marine Resources Department, July, 1979).

The fresh marsh community also provides habitat for a diverse assemblage of wildlife species. The main value of the community to wildlife is derived from its "ecotone" or "edge" nature. Ecotone areas tend to exhibit high community productivity and species diversity because they provide a wide variety of habitats, and the fresh marsh community is no exception. Resident, transient, and migrating birds of both terrestrial and aquatic origin utilize food and shelter found in this community; some species use freshwater marshes for nesting and breeding. Waterfowl feed directly upon fresh marsh vegetation. Wild rice, sedges (Cyperus spp.), bulrushes (Scirpus spp.), and duckweeds serve as prime waterfowl food, and mollusks, insects, small crustaceans, and fish found in the fresh marsh community are also fed upon by waterfowl and other avian species. Various species of ducks, grebes, and geese feed on the Basin's fresh marshes, along with other species such as the great blue heron, green heron, snowy egret, and other migratory birds.

The Basin's fresh marshes also provide habitat for fur-bearing marsh mammals which use the vegetation as a sheltered foraging area,

direct food source, and building supply for their lodges. These mammals include the muskrat, mink, beaver, and river otter. Terrestrial species from surrounding areas often utilize the fresh marsh edge for shelter, food, and water; these include raccoon, opossum, rabbit, and bobcat.

3. Open water.

The open water community in the Basin is composed of freshwater lakes, ponds, reservoirs, and streams as well as some brackish water areas in the lower Waccamaw. The ponds, lakes, and reservoirs provide habitat for a variety of fish, including largemouth bass, bluegill, crappie, and catfish, and numerous wildlife species which depend upon the water for drinking, food, living space, and cover. Lake Waccamaw, the largest body of water in the Basin, supports three species of unusual fishes: two are apparently endemics, while the third is shared with Phelps Lake in Washington County, N.C. These water bodies also provide important resting, feeding, and watering places for many wildlife species, including migrating ducks and geese. Terrestrial species frequent these aquatic communities in search of food and water. Also, these standing water habitats support terrestrial frogs and salamanders during the breeding season as well as turtles and various other reptiles.

The Waccamaw River is a slow-moving, sand-bottomed coastal plain river. The river and its tributaries are freshwater streams that provide habitat for a variety of fishes, including largemouth bass, redbreast sunfish, catfish, bluegill, and crappie; pickerel and other non-game species also find excellent habitat in these waters. Tidal effects are measurable up to river mile 82, however, and during low river flows and/or high tidal action salt water may be carried as far as 15 miles

upstream (CZRC 1973). Thus, the lower reach of the river provides habitat for marine and estuarine species as the saltwater wedge moves up the river.

EXISTING FISH AND WILDLIFE RESOURCES

The Waccamaw Basin supports an abundance of both game and nongame fish and wildlife species. Fish (1968) reported that the Waccamaw River is an excellent fishing stream for largemouth bass and various sunfishes. According to Louder (1962), the Waccamaw is one of the ten best fishing streams in the Lumber/Waccamaw drainage. Dominant game fishes reported by Louder (1962) are chain pickerel, largemouth bass, bluegill, redbreast sunfish, black crappie, warmouth, and flier. Anadromous species also utilize the Basin's streams; both Louder (1962) and Lindquist (May 1980 personal communication of Lacy E. Nichols, Jr., Fishery Biologist, N.C. Wildlife Resources Commission, with Dr. David G. Lindquist, Assistant Professor and Curator of Fishes, University of N.C., Wilmington) report an anadromous fishery in the Waccamaw River.

Most wildlife species require a variety of upland and/or wetland communities to meet individual life cycle requirements and thus maintain viable populations; the diversity of vegetative communities within the Basin provides for this maintenance. Transition areas between various wetland and upland communities possess maximum variety and provide habitat for many species. Interspersion of community types within the Basin contributes to the diversity of wildlife species present. Waterfowl, bobwhite quail, mourning dove, whitetail deer, black bear, eastern cottontail, gray squirrel, and a myriad of other wildlife species find

habitat to meet all or some life requirements within the Basin. Further data collection and literature review are required to document the quality and quantity of the Basin's fish and wildlife populations as well as to determine hunting and fishing pressures and harvest rates of these resources.

Threatened and Endangered Species

The Basin's many habitats support a number of plant and animal species that are endangered or threatened or are of special concern within the individual states. The Federally-listed endangered American alligator, red-cockaded woodpecker, bald eagle, and shortnose sturgeon are known to occur in the Basin; the eastern cougar may be present. Three species of fishes occurring in Lake Waccamaw were proposed for listing as endangered in the Federal Register on December 30, 1977. As amended November 10, 1978, the Endangered Species Act mandatorily withdraws proposed rules to list species which have not been finalized within two years of the proposal. The time limits expired on these fishes and notice of their withdrawal appeared in FR 45(17):5782 on January 24, 1980. However, this withdrawal of proposed rules for listing these species does not preclude further action to attain endangered status for them.

Currently, no endangered or threatened plants are known to occur in the Basin, but two species that may be present were proposed for Federal listing and 14 additional species were under status review. In addition, numerous species of concern to the states of North and South Carolina are also found throughout the Basin.

The Service suggests that early during Stage 2 studies the Corps request a list of endangered and threatened species which may occur within the Basin, since, according to Section 7(c) of the Endangered Species Act Amendments of 1978 (P.L. 95-632), the Corps must request this list. (The information provided in this report does not constitute this required list.) Early awareness of potential impacts on endangered species and coordination with the FWS will assist the Corps in meeting the requirements of the Endangered Species Act. Your written request for this list of species should be directed to the Area Manager, Fish and Wildlife Service, Plateau Building, Room A-5, 50 South French Broad Avenue, Asheville, North Carolina, 28801, and the Regional Director, National Marine Fisheries Service, Duval Building, 9450 Koger Blvd., St. Petersburg, Florida, 33702. After receipt of the list of species which may be present, the Corps is required by the Act to "conduct a biological assessment for the purpose of identifying any endangered or threatened species which is likely to be affected by such action. Such assessment shall be completed within 180 days after the date on which initiated (or within such other period as is mutually agreed to by the Secretary and such agency) and, before any contract for construction is entered into and before construction is begun with respect to such action. Such assessment may be undertaken as part of a Federal agency's compliance with the requirements of Section 102 of the National Environmental Policy Act of 1969 (42 U.S.C. 4332)" (Section 7(c)).

Should a non-construction project as defined in the proposed Inter-agency Cooperative Regulations be recommended, the Corps must still initiate formal consultation for any listed species that may be affected

by the project. If it is determined that there will be no effect on listed species or their habitat, further consultation is not required.

Section (d) of the Act underscores the requirement that the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any endangered or threatened species.

Unique and Sensitive Natural Areas

In addition to endangered species habitat, the Basin possesses other natural areas that may be classified as "sensitive" or "unique": 1) locations of rare and endangered species habitats; 2) exemplary plant communities and ecosystems; 3) special wildlife habitats, and 4) unique geologic features. These areas provide "living laboratories" where plants and animals can be studied in their natural environment and are havens for a multitude of species, some of which can survive nowhere else.

Statewide inventories of the Carolinas' most significant natural areas are maintained by the Natural Heritage Program in North Carolina and the Heritage Trust Program in South Carolina. The natural areas inventories maintained by these two groups are quite extensive and focus on the elements or components of natural diversity, including those that are exemplary, unique, or endangered on a statewide or national basis. The preliminary assimilation of existing data is followed by verification, intensive field surveys, and searches for unknown or better examples of under-represented components. Finally, the Heritage inventories ar

continuously updated and refined, thus improving the ability of experts to identify, evaluate, and protect the States' natural areas.

The Heritage inventories document the occurrence of unique and sensitive natural areas in the Waccamaw Basin. Certainly, some such areas have not yet been identified and placed on the Heritage inventories, but these inventories do represent the most comprehensive listings available. Typical natural areas include Carolina bays with rare or endangered plants (or animals), unique geologic features, forests with outstanding growths of trees, and freshwater ponds with excellent stands of cypress or very diverse surrounding vegetation. Unfortunately, these areas are easily destroyed due to a lack of awareness of the areas and/or lack of understanding of their ecological significance. To avoid the inadvertent destruction of the Waccamaw's natural areas, further identification and evaluation of existing and potential natural areas in the Basin are needed.

MAJOR FISH AND WILDLIFE-RELATED PROBLEMS

Preliminary review indicates that the major fish and wildlife-related problem in the Basin is likely the loss of wetlands and other valuable or unique wildlife habitat. Conversion of wetlands to agricultural, industrial, commercial, or residential use and conversion of hardwood or mixed pine-hardwood forests to pine monoculture have occurred throughout the Basin. Fortunately, the extensive riparian development common to many coastal rivers has not taken place along the Waccamaw River and high quality wildlife habitat is still present in the Basin. And, due to the rural nature of the Basin, the river receives little municipal or industrial pollutant loading. Agricultural and silvacultural activities,

however, are often major sources of pollution - nutrients, pesticides, sediments - and although these sources do not appear currently to be a major problem, their impact on the quality of aquatic habitat in the Basin needs evaluation.

Associated with both the loss of wetland habitat and potential pollution of the Waccamaw River and its tributaries is the general lack of local floodplain management programs that insure wise use of the Basin's floodplains and flood-prone areas. Throughout the nation, wetland areas have suffered modification and destruction as man has attempted to "reclaim" them and convert them to dry land uses. Development typically destroys or severely reduces the natural beneficial values of such areas and increases the risk of flood damages, including loss of property and human life. Unwise and inappropriate uses create a no-win situation which results in increased flood damages accompanied by increased requests for and construction of flood protection projects. Such projects have typically involved modification of the water regime (keeping the water away from the people) which affects both the wetlands dependent upon that regime and future floodplain development of not only the immediate site but downstream (and potentially, upstream) areas as well.

Impacts of structural flood control projects involving channelization and other forms of stream modifications on aquatic resources can be devastating, as shown in many studies on North Carolina streams. Bayless and Smith (1965) reported drastic reductions in both numbers and weight of game fish following channelization, while Huish and Pardue (1978) recorded higher total weights of fish per unit area in unchannelized verses channelized streams. Canopy removal associated with channelization

increases ambient stream temperatures (Tarplee, Louder, and Weber 1971). Gr:sw l et al. (1978) found macroinvertebrate abundance, diversity, and biomass, as well as diversity and relative abundance of the total fish community, were significantly lower in channelized streams. Holder (1973), Tindow (1973), McSwain (1973), Pasch (1974), Ober (1976a, b), Pasch (1976a, b), and Ober (1977) have investigated warmwater streams in Georgia similar to the Waccamaw River and have documented harvest rates, utilization rates, food habits, age and growth, and relative abundance of selected streams and rivers. Their findings indicate the potential damage that might occur in the Waccamaw Basin should extensive drainage projects be undertaken.

In addition to the direct losses of wildlife habitat resulting from floodplain/wetland development and subsequent flood protection measures are the secondary impacts of such measures. In a one year study in Missouri, Fredrickson (1977) documented the secondary impacts of a channelization project on adjacent bottomland hardwoods: as drainage improved, more wetlands were cleared by landowners for row crops than were lost during channel construction.

Impacts on fish and wildlife resources of flood control and drainage projects necessitated by unwise, inappropriate use of floodplain/wetland areas can be significantly adverse. Without an active and positive floodplain management program, continued development of the Basin's floodplains and wetlands is expected. Along with that development will occur further habitat deterioration and loss, increased threats to fish and wildlife dependent upon that habitat, increased flood damages, and increased costs for flood damage protection. Should implementation of flood control measures in the Waccamaw Basin prove feasible, adherence to

Corps' policy on flood reduction measures would help minimize the above-listed impacts and make a positive contribution to solution of the Basin's fish and wildlife-related problems while providing for reduced risk of flood damages. Key points of this policy guidance are listed below:

1) as a prerequisite for Federal implementation of a flood damage reduction project, the local sponsor is required to adopt floodplain management programs in and adjacent to the project area;
2) consider the formulation of a mix of structural and nonstructural measures to reduce flood losses and that these measures must make a positive contribution to the national objectives of National Economic Development (NED) and Environmental Quality (EQ);
3) renewed emphasis on recreational and environmental use of evacuated floodplains;
4) the formulation of plans to provide a level of protection that would insure wise use of the floodplains rather than some predetermined level of protection. . . (U.S. Army Corps of Engineers 1981).

FISH AND WILDLIFE PLANNING OBJECTIVES

We recommend the following objectives be utilized in future planning efforts:

1) Provide for conservation and enhancement of fish and wildlife resources in the Basin.

2) Protect rare, unique, and sensitive habitat areas within the Basin.

3) Enhance recreational opportunities associated with fish and wildlife resources in the Basin.

FUTURE FWCA ACTIVITIES

The Fish and Wildlife Coordination Act directs the Service to determine the possible damage to fish and wildlife resources likely to result from a water resources development project and the means and measures that should be adopted to prevent the loss of or damage to such resources. In order to fulfill these responsibilities, the Service has identified certain FWCA activities that must be accomplished during Stage 2. These include the following general activities:

1) identify alternatives or modification to alternatives that will address fish and wildlife-related planning objectives;

2) provide for each intermediate-level alternative a with and without-the-project analysis that:

   a. describes the significant fish and wildlife impacts;

   b. evaluates the fish and wildlife trade-offs;

3) identify appropriate conservation measures for those alternatives most likely to be carried into Stage 3;

4) indicate the alternative(s) most acceptable from a fish and wildlife conservation standpoint;

5) provide the above information in planning aid report(s) early enough for consideration in the Stage 2 Documentation Report (milestones 03, 23).

The following specific activities will be necessary for the Service to accurately and adequately address the fish and wildlife resources of the Waccamaw Basin, assess the impacts of various alternatives, and make necessary recommendations for mitigation/compensation. The estimates are based on prior experience in river basin studies, our existing knowledge of the fish and wildlife resources of the Basin, and the Corps' Stage 1 findings which identify problem areas and potential solutions worthy of Stage 2 investigation. Included are estimates for instream flow analyses using the Service's IFG incremental methodology, essential to evaluate impacts of any proposed modifications of existing streamflows on fishery resources, and for habitat evaluation procedures needed to perform wildlife habitat assessments, tradeoff analyses, and compensation analyses. Funds requested are based on projected FY 82 costs in the Charleston Field Office plus a 10 percent operating cost increase, as these funds will not be requested until at least FY 83. Any change in actual biologist-day cost will be taken into account during the development of specific Scopes of Work and the transfer of funds.

Stage 2 Involvement

Activities	Biologist Days
Literature Review	5
Fish and wildlife resources -- 3	

Activities	Biologist Days
Impacts associated with specific construction alternatives -- 2	
Field Surveys	26
Preliminary -- 4 Vegetative -- 15 Resource inventories -- 7	
Habitat Mapping	28
Photointerpretation and map preparation -- 20 Ground truthing -- 5 Analysis -- 3	
Instream Flow Needs	30
Data collection (5 sites) -- 20 Data analysis -- 10	
Evaluation of Alternatives (Habitat Evaluation Procedures)	50
Prefield (review/develop models) -- 5 Field (6 cover types) -- 15 Data analysis (5 alternatives) -- 30	
Resource Use	8
Data retrieval -- 3 Data analysis -- 5	
Coordination with Corps and other federal and state agencies	8
Stage 2 Planning Aid Report Preparation	15
Total Biologist Days	170
Cost at $220/BD	$37,400
38% Service Overhead	14,212
Total Cost	$51,612

General activities required during Stage 3 are shown below:

1) fully describe the significant impacts associated with each alternative. Impact will be linked as possible to the features of the various alternatives responsible for the impacts, and their incidence (location, timing, and duration) specified;
2) identify the fish and wildlife trade-offs associated with each alternative;
3) identify the plan most acceptable from a fish and wildlife standpoint;
4) fully describe and justify those fish and wildlife conservation measures that should be included as integral parts of the preferred plan;
5) a preliminary draft FWCA report will be submitted early enough for consideration in the preliminary draft survey report submitted to division (Milestone 06; 26);
6) attend Stage 3 public meeting;
7) finalize FWCA report in time for inclusion in the final survey report submitted to division (Milestone 10; 30).

Estimating the time required for specific Stage 3 activities is very difficult at this point, as the required time will be directly related to the number and types of alternatives and the potential impacts of the actual recommended plan. Depending upon the alternatives, special studies may be required to adequately evaluate their impact on fish and wildlife resources and to develop detailed mitigation/compensation

plans. The following list includes activities the Service can identify at this time as essential and must be considered a preliminary estimate for input into the budget request. The Service will work with the District to refine needed FWCA activities as the study progresses.

Stage 3 Involvement

Activity	Biologist Days
Impact assessment and trade-off analysis for each alternative	15
Identify plan most acceptable from a fish and wildlife standpoint and develop conservation measures that should be included as integral parts of the preferred plan, including detailed compensation plan if appropriate.	15
Coordinate with Corps and other federal and state agencies; attend public meeting(s)	12
Prepare draft and final FWCA report	40
Draft -- 25 Final -- 15	
Total	82

@ $220/BD	$19,040
38% Service Overhead	$ 5,955
Total Cost	$24,995

CONCLUSION

The Waccamaw River Basin is an ecologically significant basin with valuable fish and wildlife resources. Much of the significance of this basin stems from the wetlands that occur throughout the area and the valuable and often unique plants and animals that inhabit these areas. Unfortunately, inappropriate development of wetland and flood prone areas in the Basin

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has resulted in requests for flood protection measures, many of which are detrimental to existing wetlands and other fish and wildlife resources.

Future study efforts should focus on solutions that would not adversely affect the Basin's valuable fish and wildlife resources. Any recommended action should incorporate features that contribute positively to Environmental Quality objectives and not simply minimize fish and wildlife losses. The figures presented above represent our best estimate for future FWCA activities that will be required during stages 2 and 3 to meet these goals. These activities will be funded on a fiscal year basis which corresponds to the Corps' schedule on the study; however, without the Corps' projected milestone schedule, we cannot provide the funding request by fiscal year. To avoid inadequate funding early in the study, we request the Corps coordinate with us in making specific FY funding requests.

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